Ja 6 '08

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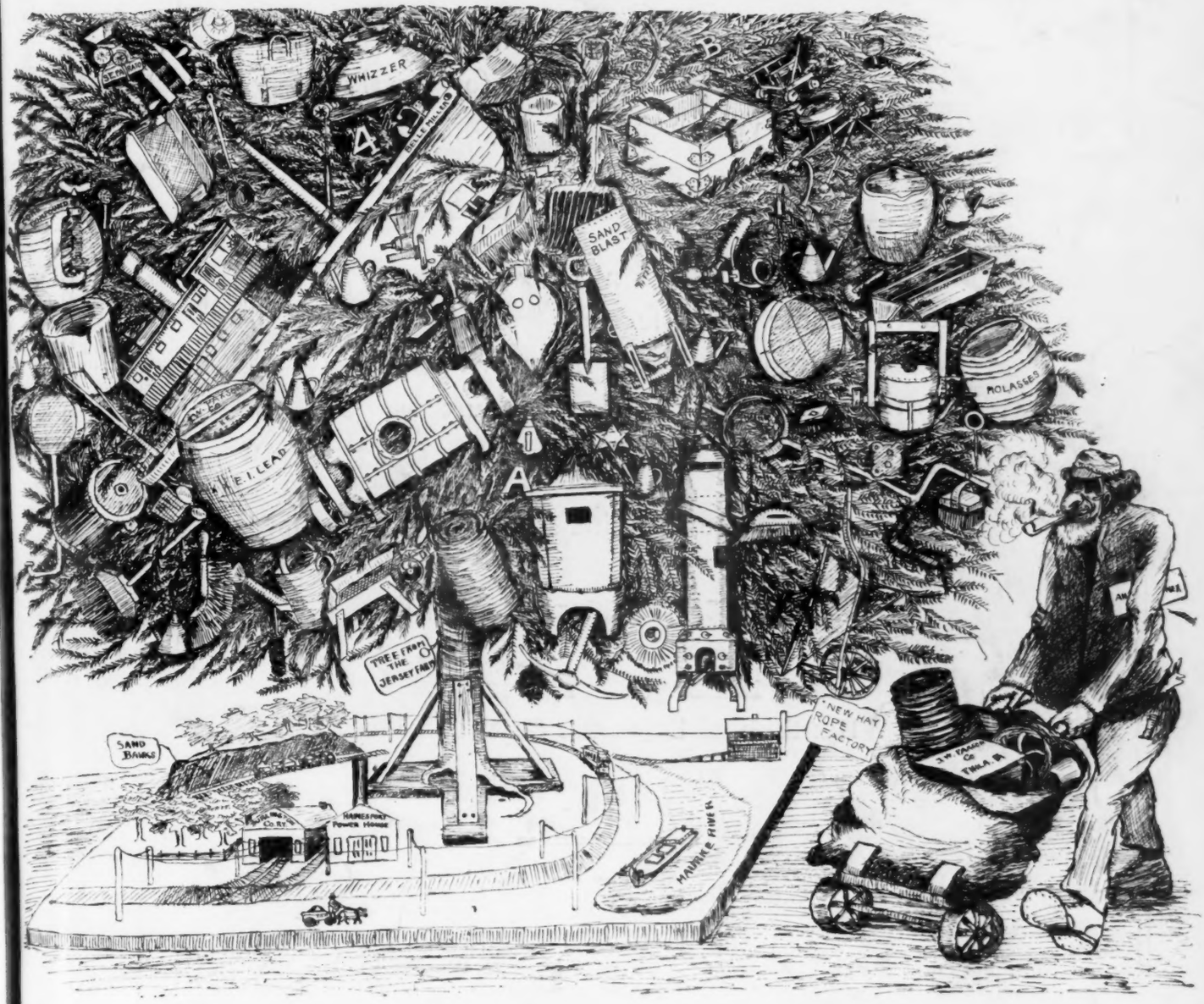
THE FOUNDRY

OF DETROIT

"NEW YEAR GREETING."



May the New Year and the good times a'comin' fill your hearts and purses with joy and shekels.

J. W. PAXSON CO.

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Start the Year Right

by using the highest quality of

Foundry Facings and Blackings

We are not beginners. We have been manufacturing this class of goods for nearly forty years, every year our

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Notice how many will say "just as good as Obermayer's".

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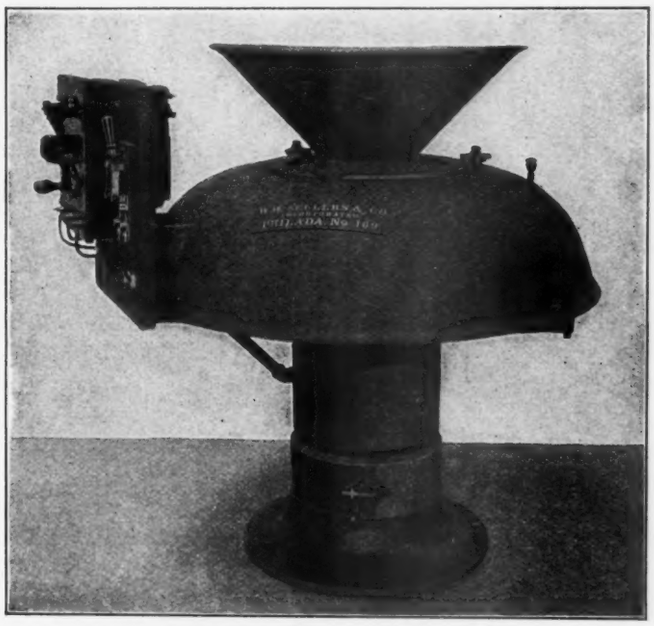

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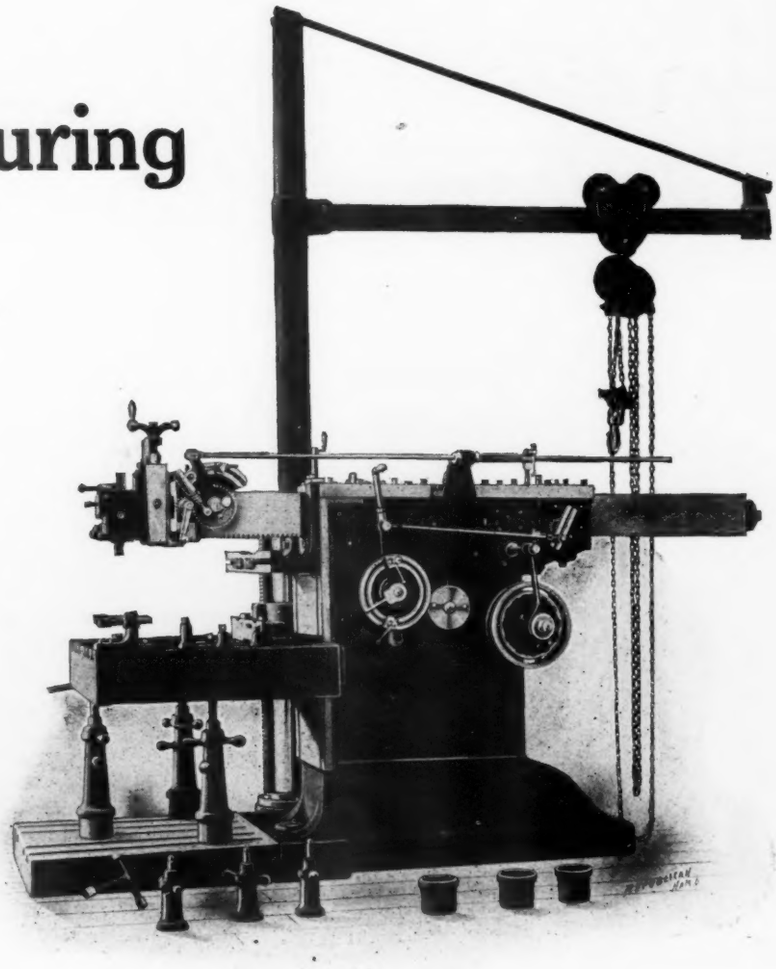

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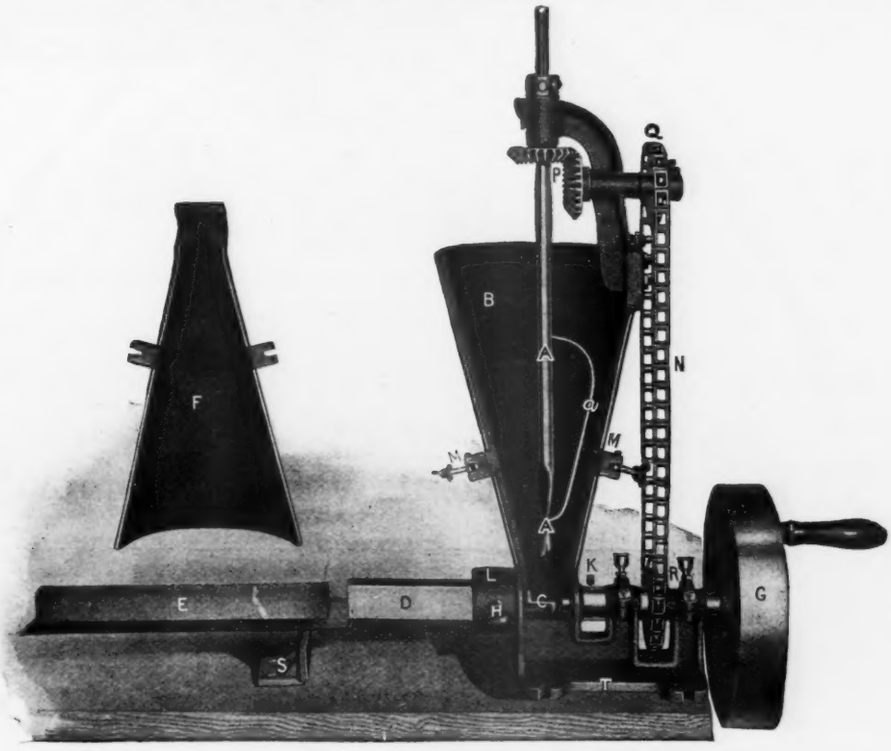

THE above cut was made especially to show the advantages of the upright or force feed, "A" being a device peculiar to this machine, fully covered by our patent and not employed in any other machine. It agitates the sand and prevents it from getting caked or set in the hopper "B." By means of the twisted blade "A," the sand is forced upon the conveyor "C," which transmits and packs it into the tube or die "D," which gives form to the core. The force feed insures steady and regular feed and supplies sand to the conveyor as long as there is any in the hopper. The twisted conveyor or bit delivers the sand in such a manner that the core is one continuous core of equal strength throughout, and not a series of short cores liable to part easily, as formed by plunger machines.

The vent in the core is formed by the pin on the end of the conveyor which projects into the tube, while the core is being formed, and the vent may be made larger or smaller by changing the size of the pin when the bit is made.

This machine makes straight cores in any shape from 3/8 to 3 inches in diameter.

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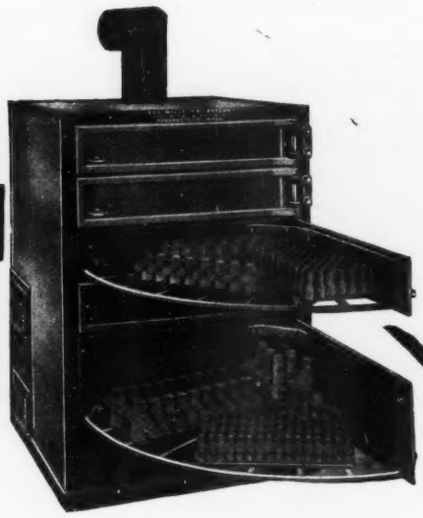

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distinguishing points which predominate

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Talk with a user—then if you don't buy
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A LIQUID ADHESIVE

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¶ Is absolutely regular in quality---it never varies in strength or composition.

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¶ Would you like to know that price---or better still, order that sample barrel today? A short letter will turn the trick.

Make this day---your day.

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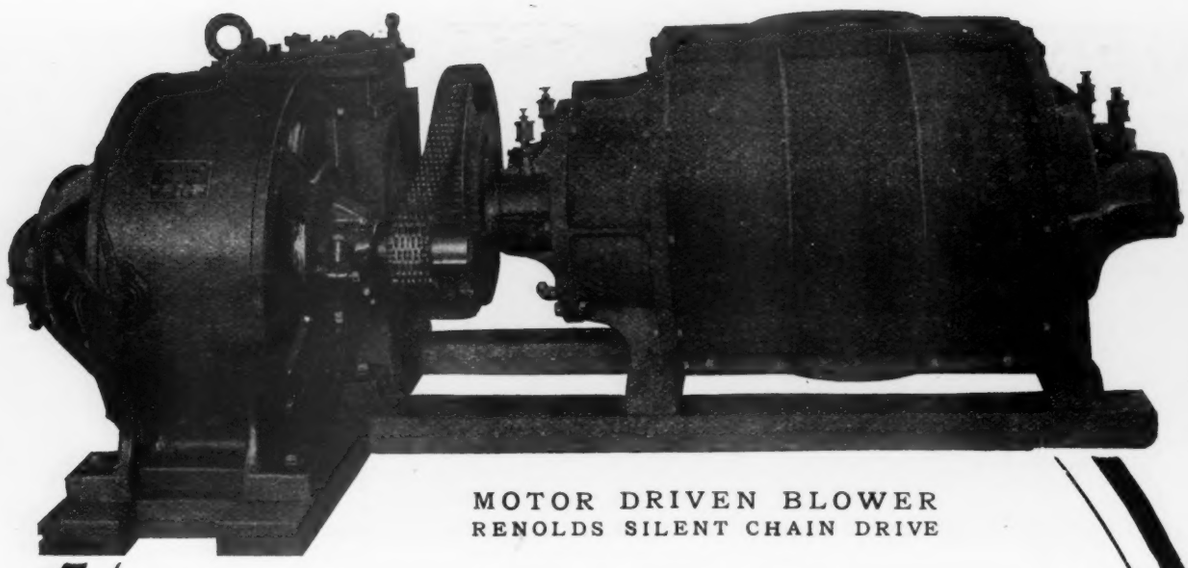

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is earning money for others. Why not also for you? Said a General Superintendent of one of the largest iron works in the United States, after recently installing one of our No. 6 A blowers:

"It reduced the time in running our heat the first day, one hour."

Wilbraham-Green Blower Company

2518 FRANKFORD AVENUE

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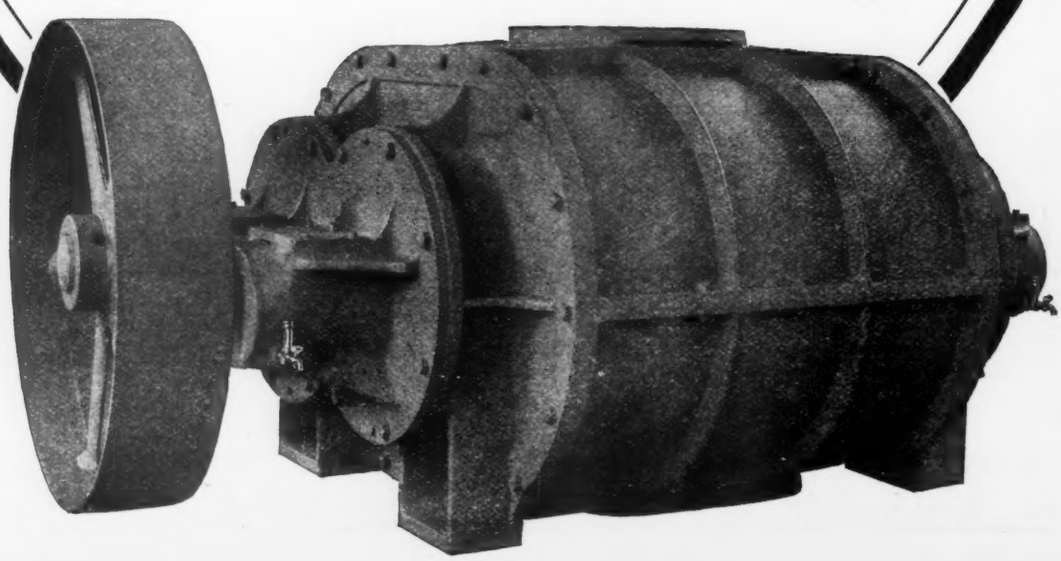
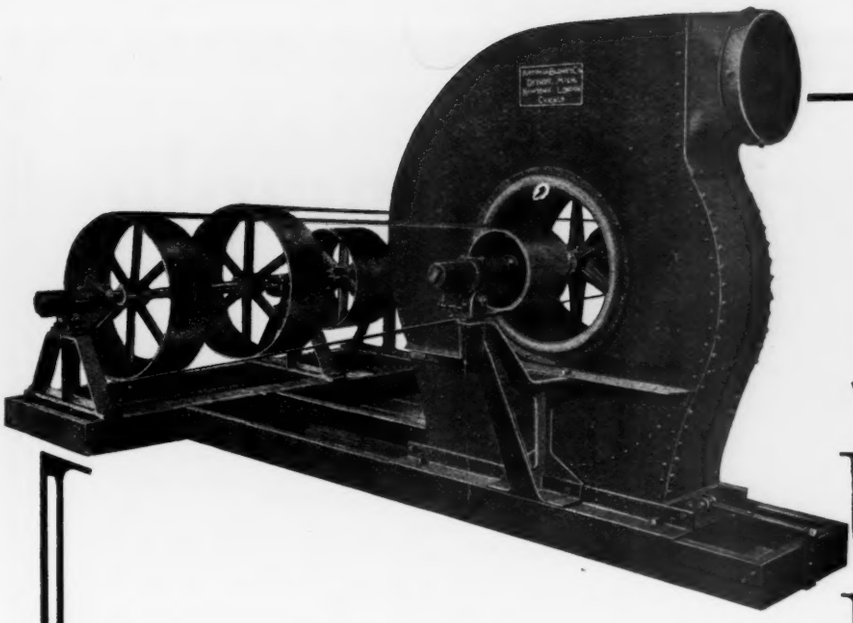
1854 **1908**





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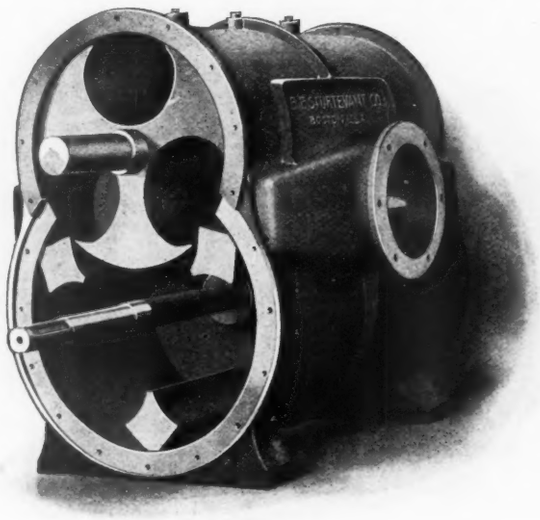

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655

1908

Wishing you all a Prosperous New Year

THE year 1907 was good to us. For **1908**—we aim to **triple** our sales. **"We will succeed with your co-operation."** We have built wisely and well. Our foundation of success has been built on a bed of **"Truth, Quality and Liberality."** The dollar is a second consideration. Rather **"Satisfaction than Pay."** You whom we have sold, accept our appreciation. **Foundrymen, "Brass and Steel,"** we want your orders. **Crucibles essential always.**

THE ONLY AND ORIGINAL

"Steele Harvey"

CRUCIBLE METAL MELTING FURNACE

(Patented in all countries)

IN MELTING POSITION

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OUR CLAIM FOR YOUR BUSINESS

Our system of **brass** melting, likewise for **ferro-alloys** is recognized by all leading founders as the only practical solution to old method of melting by "coal or coke." By its aid you are the master of the shop. **No experience needed, saving in fuel,** increased life of crucibles, **less loss of metal,** either Fuel Oil, City or Natural Gas.

"50%" saved

Shipped on approval within a reasonable distance.

Built in all Sizes and Styles. Immediate delivery.
Prices low. Settlements mutually agreeable.
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The Monarch Engineering & Mfg. Co.

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Schwartz Melting and Refining FURNACE

In sizes from 100 lbs. per heat to 10,000 lbs. Capacity.

The Pioneer in Brass and Copper melting furnaces. The most Economical and Durable.

The Ohio Brass Co.

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Write for new catalogue.

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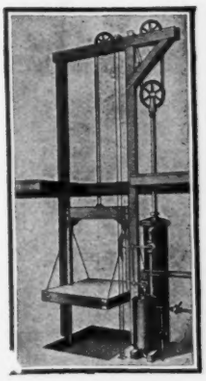
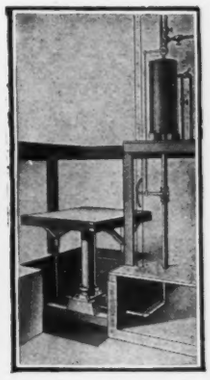
God Told Moses





To tell the Jews that every seventh year should be a sabbath year.

They were to go slow and rest.

The world has always thought it knew more than God and has refused to come into its sabbath year reverently, expectantly and gently.

So we get knocked into it with a club.

And here we are. How do you like it?

The papers record the wrecks.

Millions have been lost.

Will the victims please hold up the hand?

"But what has all this to do with Steam-Hydraulic elevators?" I don't know.

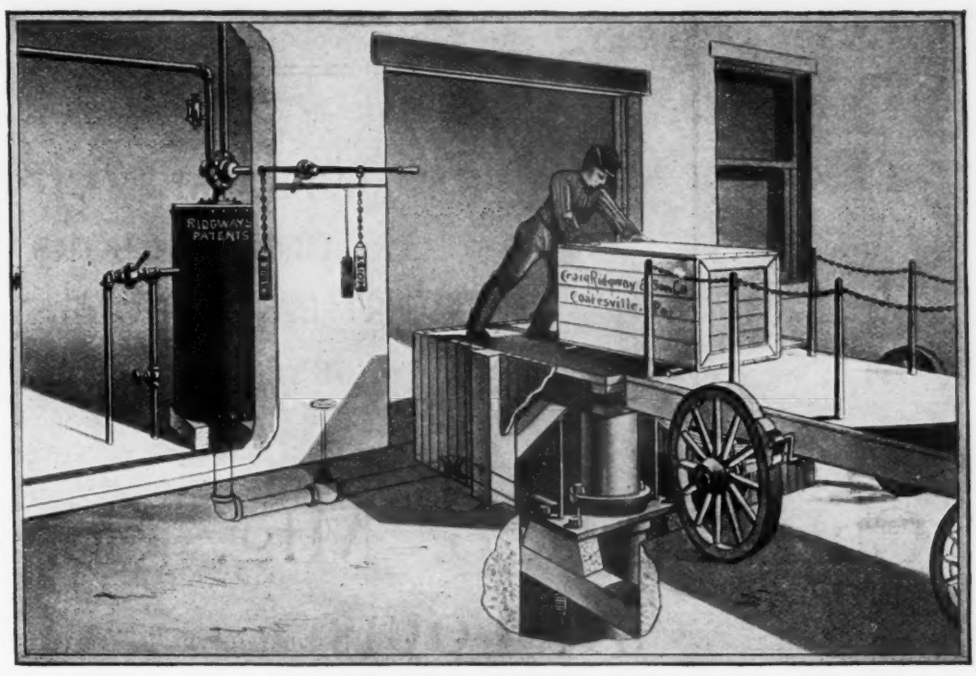
Unless perchance to suggest that in this year of skinny order book and hard collections you may find time to do a little thinking. Something like this:

A concern like the Ridgway establishment would not say they were furnishing hydraulic elevators that run without cost if it were not so. Nor would the great establishments all over the land be putting them in by hundreds if there was not a good reason to

Hook'er to the Biler

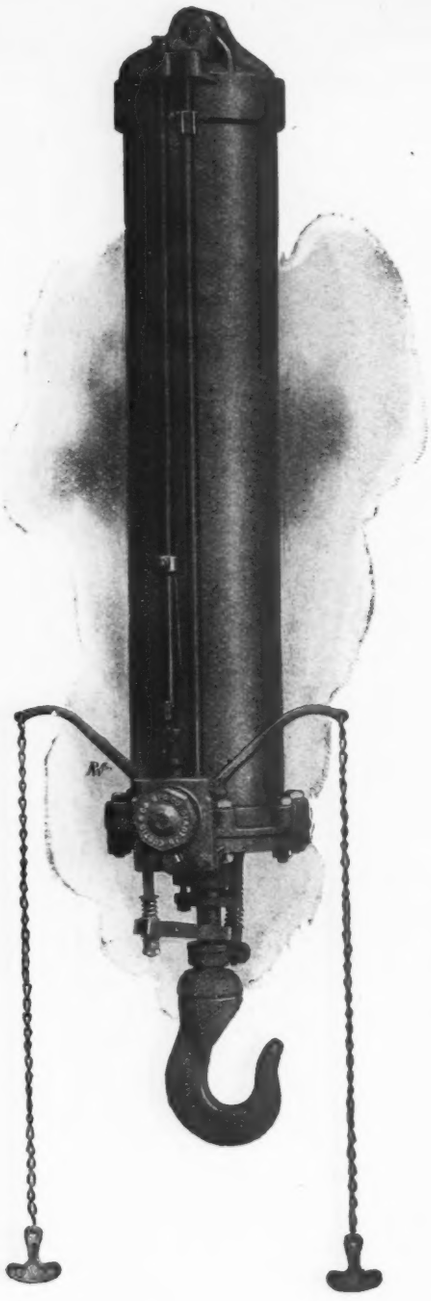
CRAIG RIDGWAY & SON COMPANY

Coatesville, Pa.



Greatest Modern Money Saver

The CURTIS HOIST



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NO JUMP
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Will Handle the Most Difficult Moulding

Made in sizes from 3" diameter 450 lb. capacity, to 19" diameter 20,000 lb. capacity.

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THE FOUNDRY

Vol. 31, No. 5 CLEVELAND, OHIO, JANUARY, 1908 Whole No. 185

AN ORNAMENTAL BRONZE FOUNDRY

Description of the New Plant and Product of the Henry Bonnard Bronze Co., Mt. Vernon, N. Y.

A FOUNDRY with buildings of ornamental design, located in a park-like expanse of well-kept lawn, lined with carefully trimmed walks and walled in on three sides by great forest trees; with its offices paneled in white and all its departments, excepting only those directly connected with the pouring the metal, almost as free from grime and rubbish as a residence—this is the unusual sight to be found at Mt. Vernon, New York, where the works of the Henry Bonnard Bronze Co. are located.

This company is probably without a rival to the claim of having the cleanest foundry in America. What is of more importance, it can substantiate the claim of having wrested from France and Germany their long-maintained monopoly in the production of art castings in bronze, silver, gold and other metals. Today it is turning out a line of work which, from the smallest ink well or paper weight up to sculptured equestrian figures of life size, does not suffer by comparison with the products of foreign foundries.

New Line of Work.

In recent years a rapidly growing line of work has been found in heavy ornamental bronze doors for public buildings, bank fittings, grilles, roof and window details, chandeliers, lamp standards and the thousand and one other ornamental forms which the architect-sculptor is designing for the more pretentious buildings of today. Bronze tablets, too, have always been a specialty with this concern, and its products in this line include many of large proportions and intricate detail. At these works was cast in gold the life size portrait-statue of Maude Adams, requiring 812 pounds of pure gold, worth about $110,000.

FIG. 1—CHANDELIER FOR THE STATE CAPITOL, HARRISBURG, PA., (17 FEET 10 INCHES HIGH, 7 FEET 8 INCHES IN DIAMETER, WEIGHT, 7,311 POUNDS) COVERED WITH GOLD LEAF

Though in appearance their products little resemble those of the commercial foundry, these works are none the less essentially a bronze foundry proposition. The effort is directed toward the artistic perfection, rather than the maximum strength and mechanical accuracy of the castings—yet castings they are, and the methods employed to produce them are not materially different from those prevailing in the ordinary jobbing foundry.

Historical.

The business now conducted at these works was established in 1871 by E. Henry and P. A. Bonnard. For 30 years it was carried on in New York City, most of that time at 430 to 444 West Sixteenth street, but in 1906 was removed to the suburban town of Mount Vernon, where some $300,000 was expended in a new plant. The company is now controlled by ex-Senator William A. Clark and is one of the interests in the control of which he finds particular pleasure. It is under the direct management of Eugene F. Aucaigne, from whose plans the present plant was erected. This is a model of its kind, embodying those features commending themselves during his long experience in art foundry work, both in America and France.

Arrangement of the Plant.

The arrangement of the two principal buildings of the plant are such that the departments devoted to the various steps in the production of the finished casting, and its shipment or display, are in regular order, running

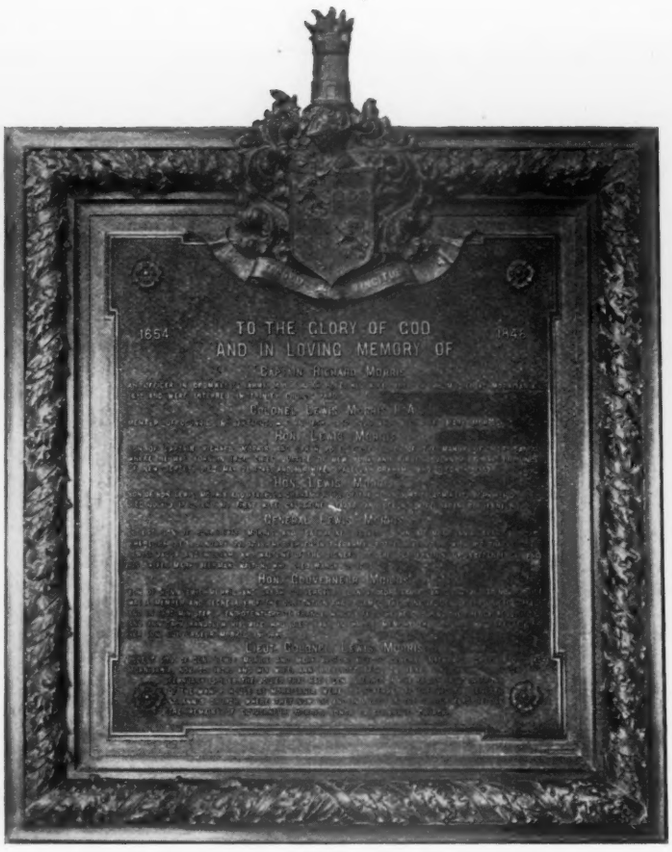


FIG. 2—A FINE EXAMPLE OF LARGE BRONZE TABLET WORK

FIG. 3—BRONZE MEMORIAL TABLET. BOARD OF EDUCATION, PITTSBURG

from front to rear of the foundry building, across a runway and then from back to front of the finishing building. At the front of the former building is a small drafting room, sharing the street outlook with a more ample room for the manufacture and storage of wooden patterns. Immediately to the rear is a still larger section devoted to plaster modeling, an important factor in the production of art works in bronze, as practically all of the larger patterns are prepared in this way. The foundry department, as shown in Fig. 8, occupies the remaining two-thirds of this building, being 75 feet wide and close to 200 feet long. The furnace pit, located on the side next to the roadway, provides space for 24 pit furnaces, and immediately opposite are the drying rooms.

A wide brick pavement connects the buildings at the back and opens directly into the finishing shop, Fig. 9, which occupies more than half of the office building. The show room, separated from this department by a semi-partition, provides ample space for the storing of finished work ready for shipment, or for the inspection of sculptors and architects. The street front of the building is divided between the offices of the manager and of the accounting department. Upstairs in this building another well-appointed show room is maintained, with a wide assortment of finished art work on display.

FIG. 4—BRONZE DOORS ON THE STATE CAPITOL, HARRISBURG, PA.

The Foundry.

Both buildings follow the usual type of a main central bay with a smaller bay on either side, a plan which lends itself well to the arrangement of the foundry. In one of the side bays is sunk the furnace pit, about 10 feet wide, 8 feet deep, and extending along the wall for a distance of 80 feet. It accommodates, in all, 24 furnaces, six of which are of 160 pounds capacity each, and 18 of 600 pounds each, making the possible melt at one time close to 12,000 pounds.

As a matter of fact, it is very rarely that even one-fourth this amount is needed for a bronze casting. The largest single piece ever turned out at these works, the bronze statue representing

FIG. 5—BRONZE BAS-RELIEF CASTING (2 FEET 8 INCHES x 8 FEET 6 INCHES)

the "Great God Pan," exhibited at the Paris Exposition, and now on the Columbia University campus, weighs but 3,260 pounds. It was cast in one piece, but the usual practice with large bronze figures is to divide them into several sections and then to pour the shell of metal relatively thin.

Statue of Senator Hanna.

The St. Gaudens statue of Senator M. A. Hanna, the last work of that eminent sculptor, was cast late in October of this year. It was poured in four sections, the head constituting one, an arm and a part of the chair in which the figure is seated another, a small portion of the base a third, and the great body of the bulky figure the fourth. In the production of work of this class a thorough knowledge of bronze foundry practice must be combined with no little artistic ability, the division of the figure requiring an especial amount of skill. Yet so cleverly was this accomplished in the Hanna statue that it is next to impossible to discover just what members were cast together and where the division lines occur.

Melting Equipment.

The entire melting bay, Fig. 7, is served by a two-ton, floor - controlled traveling crane for the charging and handling of crucibles. The furnace pit is continuous, affording prompt access to any furnace through a trap door in the grating at either end. The removal of ashes is also facilitated by this arrangement.

The central bay, in which the pouring is done, is spanned by a 20-ton, cage-controlled Northern crane. Down the middle of the building is a truck runway, extending out at one end to the dipping room. This is located well back from the other buildings in a remote corner of the yard, with the idea of avoiding its fumes. Within the foundry, with turn-table connections, four sets of track lead off at right angles to the central track and lead to the drying rooms, two entering the large central room, and one each of the smaller rooms on either side. These are conveniently located just opposite the middle of the foundry. These ovens are of ordinary brick construction, steel reinforced, and bear the name of the H. Wales Lines Co., Meriden, Conn. The large oven is so arranged that the middle standard supporting its doors can be removed for the entrance of extremely large flasks. It is reached by double track and heated by six furnaces. The smaller ovens are each heated by two and will accommodate flasks up to 7 x 12 feet each, while the larger oven has floor space 28 x 28 feet.

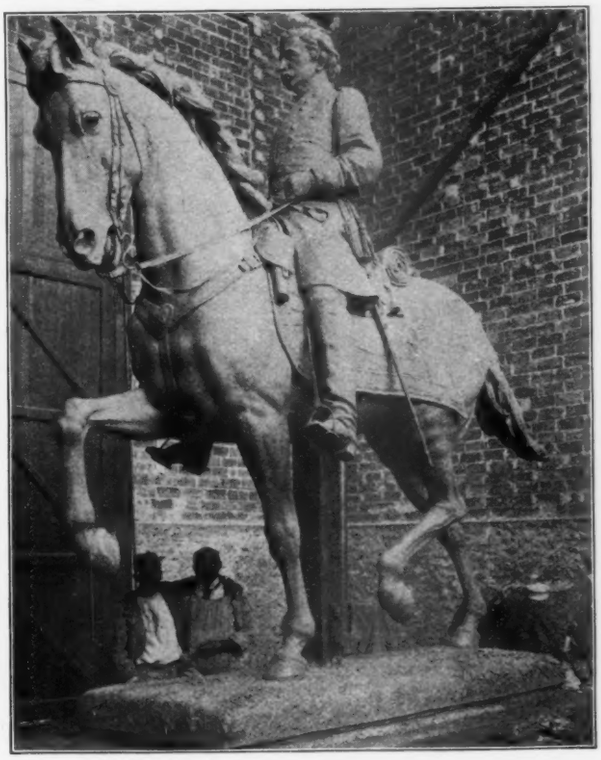


FIG. 6—LIFE SIZE BRONZE EQUESTRIAN STATUE OF GEN. WADE HAMPTON

French molding sand is employed exclusively in this foundry, a particularly fine grade being imported because of its uniform quality and of other considerations. All the newer and larger flasks are built in accordance with an elastic plan. The frames are all on a 4-inch scale, bolted together at the corners and so designed that they can be combined with any other section, and a flask can be produced of any desired dimensions, limited only by the ability of the drying room to receive it. This is a feature which has produced many economies since its introduction.

Patterns.

In the preparation of patterns, plaster, wood and wax

FIG. 7—VIEW OF THE FOUNDRY LOOKING TOWARD THE FRONT. FURNACE PIT ON THE EXTREME RIGHT. OVENS ARE SHOWN ON THE LEFT

are all employed. Most of the work turned out by this foundry is such that but one reproduction is required, and durability of the pattern is hence not important. Practically all the larger pieces of statuary, chandeliers, ornamental castings for buildings, etc., and even many of smaller size, are made from the plaster models of the artist. For reproducing these in either enlarged and reduced size there has been provided a pantagraph arrangement, operating as the model is turned on a graduated base, blocking out the figure in soft plaster on another graduated base with mechanical accuracy. For bronze tablets, doors, bank fit-

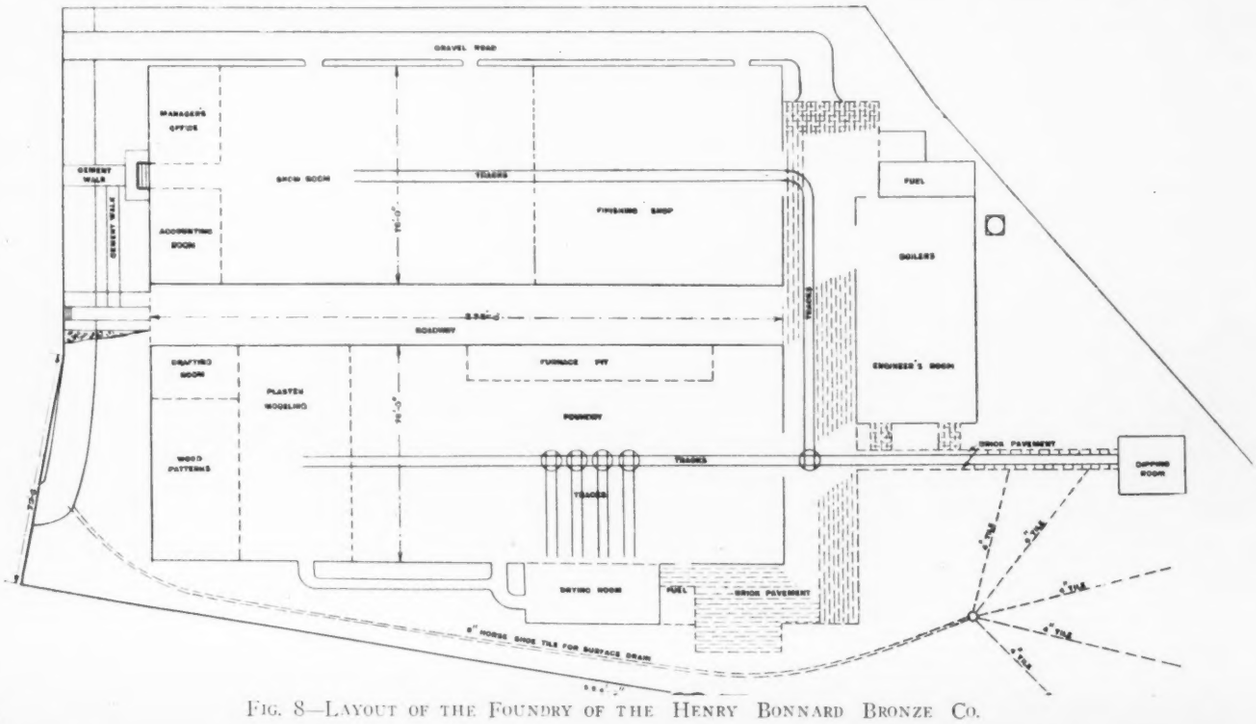


FIG. 8—LAYOUT OF THE FOUNDRY OF THE HENRY BONNARD BRONZE CO.

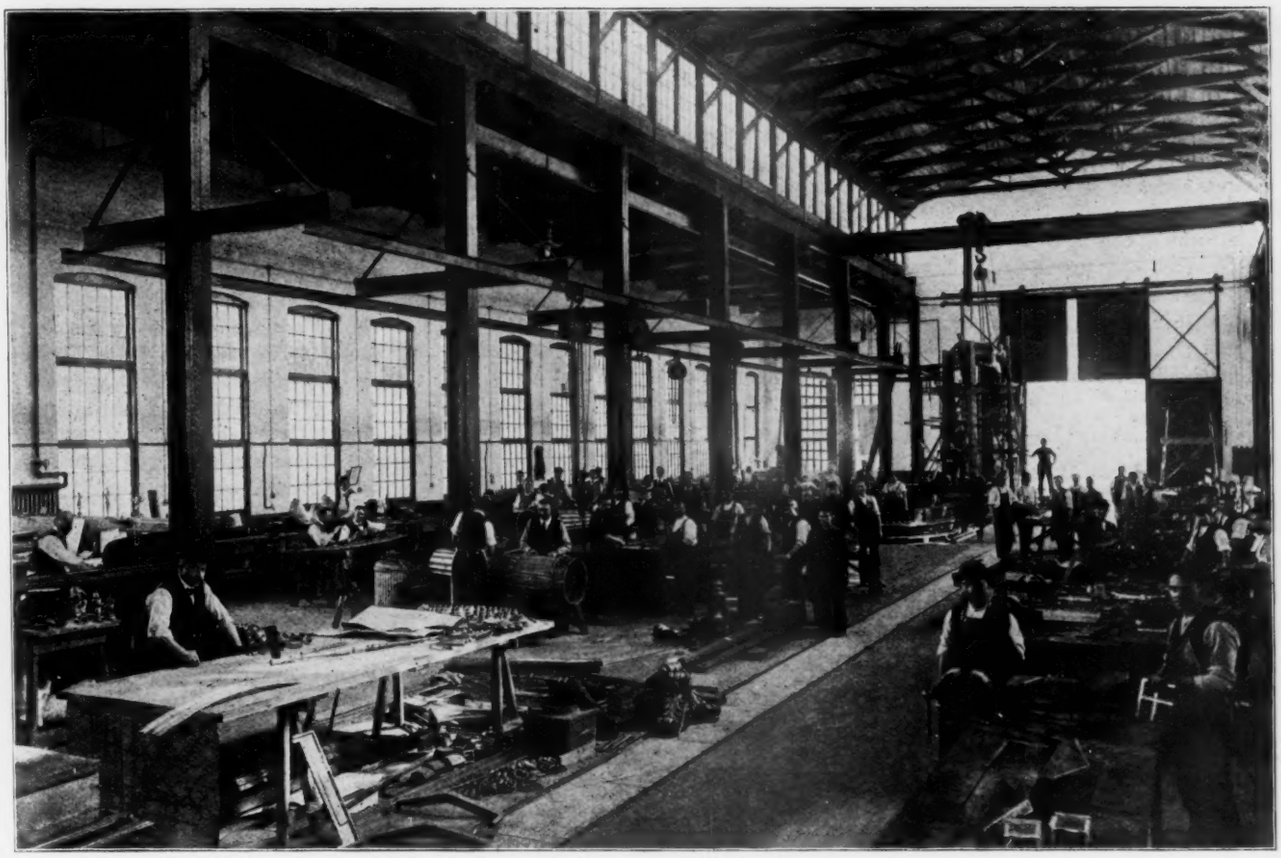


FIG. 9—VIEW OF THE FINISHING ROOM LOOKING TOWARD THE REAR

FIG. 10—ANOTHER VIEW OF THE FOUNDRY

tings and all similar flat work the wood pattern is used, with frequently a small section of intricate relief work, such as seals, small ornamental designs and other incidental details, built up in wax. For tablet work involving a large amount of lettering, the jig saw is utilized to cut out the letters which can then be re-arranged until perfect spacing is secured, when the letters are glued to the board. Borders are built up of strips of molding, some extremely handsome designs being worked out in this manner.

The Finishing Department.

The equipment of the finishing room is complete, but not elaborate, inasmuch as the bulk of finishing work on bronze art work is done by hand. A 10-ton crane covers the central bay of the building and a number of hoists are attached to I-beam tracks supported on cross arms secured to the uprights between the middle bay and one of the side bays. A set of tracks run the length of the building, connecting at the rear with tracks for the foundry. The polishing department is located in a building removed from the plant, storage facilities being provided in the same buildings. A low partition separates the finishing room from a large section immediately in front. This is curtained off with heavy hangings and serves as a display room where sculptors can inspect their work before it is shipped.

Shipping facilities are provided by a switch from the New York, New Haven & Hartford, running along the rear of the property convenient to the fuel room at one end of the power plant. Two 150-horsepower Aultman & Taylor boilers, two 130-horsepower Harrison boilers, and two direct-connected General Electric Co. generators of equal capacity make up the power equipment. Air compressing apparatus is now being installed.

The well-kept condition of the entire plant is purposely so, as it is considered necessary in the production of high-grade art work. Even the tree-fringed grass plot at the rear of the works has its own mission to perform. The models and finished castings of those statues destined for outdoor positions are run out on tracks to the center of this plot, so that their general effect against a background of grass and trees can be studied. Occasionally this leads to some important alterations in the model. The workmen at the plant are practically all foreigners, principally from the foundries of Germany and France.

A TROUBLESOME DRIVING BRASS CASTING

Difficulties Experienced in Making a Locomotive Bearing and How They Were Overcome

BY LOUIS LUHRSEN

ANY ONE who has ever made driving brasses will admit that the word troublesome is used advisedly. About a year ago we received an order for four driving brasses for one of our high speed passenger locomotives. We were instructed to be very careful with these brasses and to hurry them with all possible speed, as the engine was wanted for immediate service. These brasses were exceptionally heavy in the crown and the thickness of the sides was out of proportion to the section referred to.

In molding, we used a horn gate as shown at A, Fig. 1, to prevent the metal from striking the sides of the mold. The same mixture was used that had given excellent service for years and the brasses bored out nice and clean. After they were fitted the locomotive was assigned to yard service to be broken in before being assigned to a regular run on the main line. After being out in the yard for three or four hours the left front brass was running hot. The oil cellar was taken down and repacked, but the next morning this brass was found hotter than before. In addition, the right front brass also showed signs of heating. Every one of these four brasses ran warm for

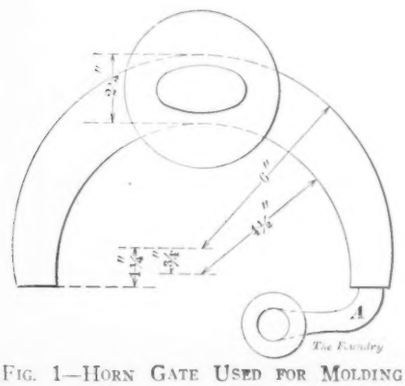


FIG. 1—HORN GATE USED FOR MOLDING

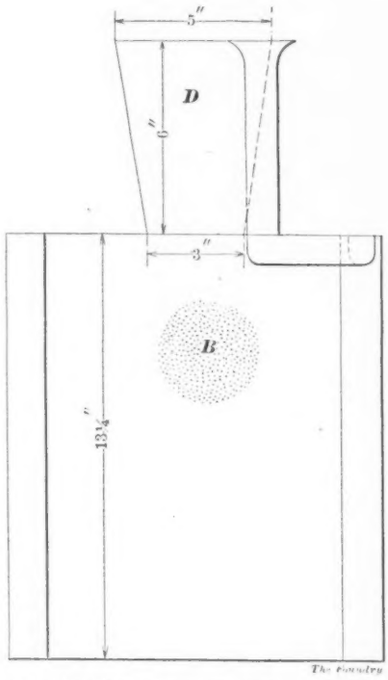


FIG. 2—BAD SPOT IN THE CASTING CAUSED BY SEGREGATION, SHOWN AT B

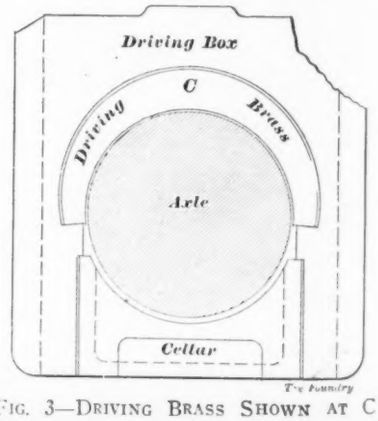


FIG. 3—DRIVING BRASS SHOWN AT C

some time, but finally gave satisfaction with the exception of the one in the left front journal, which finally burned up and had to be renewed.

In the meantime we made four additional brasses which were placed in stock. One of these was used to replace the one that failed to give satisfaction, and while it ran hot for a short time, it soon gave good service.

Oxidized Copper.

We examined the discarded casting closely and concluded that it was a bad brass, notwithstanding the fact that first class material and a mixture that had given satisfaction for years was used. The casting was broken up under a steam hammer and we found several spots that appeared dirty and spongy, but as the brass had been very hot and cracked in several places the oil worked its way into these crevices. For this reason we could not determine exactly the nature of the spongy spots. We next had a section of the casting containing one of these spongy spots analyzed and the chemist reported that while the mixture was satisfactory, the bad spots were caused by oxidized copper.

We remembered that in charging the copper into the crucible the ends of several of the pigs protruded above the pot. In this way they came into direct contact with the flame of the oil furnace and this portion of the copper was burned. We also failed to use any flux before, which was another reason why we had oxidized metal.

Believing that we had solved the mystery, we were careful that none of the copper protruded from the crucible and used salt as a flux for four brasses for the next locomotive. These castings machined well and we believed that we had overcome our difficulties. The locomotive fitted with these brasses was assigned to yard service to be broken in, but within a very few hours both of the main brasses became hot. The two rear bearings, while running warm, caused very little trouble. In explanation of the two main bearings running hotter than those in the rear it might be said that there is a greater strain on the main bearing, on account of the fact that the main side rod is attached to the main wheel.

Segregation.

Notwithstanding frequent repacking, the journals continued to run hot. The bearings were removed and broken up and in two of the castings we found large spots as shown at B, Fig. 2. These were about the size of an egg. The outside lines were irregular and ragged and toward the center they had the appearance of being torn apart. The stock brasses were broken up and we found the same defects as in those that had been in service. We diagnosed the disease as segregation and to remove the difficulty decided upon the churning head D, such as gray iron molders use with heavy castings. More than one-half of the metal contained in the head was churned into the casting. The cope was taken off at the proper time and the head broken off while still hot. We made four castings in this way and have not experienced any difficulty since. Up to the present time one locomotive in fast passenger service has covered 52,240 miles with these bearings and since that time we have made all of our heavy brasses with a churning head.

The heating of driving brasses is, however, not always due to the brass, as a bad fit by the machinist, or a fit in parts instead of over the whole surface of the journal will cause it to warm up and if watched closely it will cool as soon as the irregular places in the bearing or in the casting have worn down to a perfectly even bearing.

Charging, Melting and Pouring.

Care should be exercised in charging, melting and pouring the metal. A clean crucible should always be used with a large handful of powdered charcoal in the bottom. The pig copper should be charged on end and should be kept below the top of the crucible. If any additional copper is to be used, it can be charged after the first charge is melted. As soon as the copper begins to melt a handful of broken glass should be thrown into the crucible and when all of the copper has been melted, another handful of the glass should be added. Within a very few minutes a covering of slag will be seen over the melted copper. This is to prevent burning. The charging of the copper can then be continued until the required amount has been reached and a rod should be inserted occasionally to ascertain the condition of the metal.

When hot enough the crucible should be pulled and all the slag and dross should be skimmed off. The tin and lead is then charged and the mixture should be stirred at least three times from the bottom upward and after each operation the dross should be skimmed off. It will be found that the temperature of the metal has been greatly reduced and that it has changed its color from a bright to a dark red. This is the time to pour and it should be done quickly to prevent the metal from getting sluggish. Sufficient metal shou'd be on hand to fill the gate and head to the top.

Mixture.

The mixture we use is made up as follows: Copper, 78 to 80 per cent; tin, 9 to 11 per cent; lead, 10 to 13 per cent.

We use a No. 100 crucible and charge as follows to make up a 300-pound heat: Copper, 150 pounds; tin, 21 pounds; lead, 24 pounds; scrap, 105 pounds. The latter should consist of the same mixture as the formula. In remelting this scrap a certain amount of the tin and lead is lost and to replace this we add 2 pounds of tin and 3 pounds of lead, which constitutes a part of the mixture given above. Gates, heads and buttons left in the crucible are used as scrap.

In the November issue of THE FOUNDRY was published an article on "Brass Driving Boxes." Of late these are made of steel or cast iron, with only the crown bearing, C, Fig. 3, made of brass.

CASTING A LINER WITHOUT A PATTERN.

BY W. MAYER

We recently received a rush order for a tail shaft liner for one of the Atlantic greyhounds that had an accident at sea. In order to facilitate the work the size of the liner was telephoned us. It was to be 22 feet long and had an inside diameter of 20 inches and was 22 inches outside. While we were waiting for a sketch of the casting a 24-foot flask was brought into the foundry as well as a bar for the core. When the sketch was received the patternmaker was requested to make a core board to sweep the core and pattern for the liner.

The Core.

The core was built up of hay rope, great care being taken to allow for contraction. We were allowed half an inch inside and outside for machining. After the core was dried it was taken out of the oven and another layer of straw rope was applied to increase it to the size of the casting. After it was finished and dried again we proceeded to make the mold with this built up core as a pattern.

After the mold had been made, the core and pattern were taken back to the core room and the outer course of rope was stripped off, leaving the core.

To obviate the necessity of having core prints on the mold we rammed up the thickness on each end of the core and then placed the core back into the oven to dry the green sand which had just been added.

Melting and Casting.

The brass was melted in an air furnace and the mold was closed at 7 o'clock on the second morning following the receipt of the order. Studs were placed at various points of the core of the same mixture used in making the liner. These studs are essential in a long casting of this kind to prevent any possible sagging of the core. After the mold was upended and the runner was made the liner was cast.

An hour after casting the core bar was drawn, and the casting shaken out and laid near one of the doors to hasten its cooling. After being chipped and cleaned the liner was delivered early the same evening. The mixture consisted of copper, 87; tin, 7; zinc, 3, and lead, 3. The casting weighed about 6,000 pounds.

NICKEL ALLOYS

BY C. VICKERS

TO MELT nickel alone is difficult in the average brass furnace because of its high melting point. In producing such nickel castings as anodes, the only way to make them is to bring the furnace to the heat required to liquify the nickel, but when small quantities of nickel are to be alloyed with either copper or zinc, the easiest way to do it is to melt the most fusible metal first, later adding the nickel, or, if preferred, the alloying metals can be charged together.

Reversal of Customary Practice.

This is a reversal of the usual practice of melting the most infusible metal first and adding the others in the order of their fusibility.

There are exceptions to all rules, and to this there are many.

When scrap brass is to be alloyed with a comparatively small amount of copper, it is always the best practice to melt the brass first, afterwards adding the copper, which, when heated, is pushed into the liquid brass.

In the case of nickel, both copper and zinc dissolve it with ease, so when making alloys of nickel with these metals, advantage should be taken of this phenomenon. With lead and tin conditions are different, the nickel must be melted first and the tin or lead afterwards gradually added.

Soft Alloy.

An alloy of copper 10 pounds, nickel 5 pounds, with a small amount of aluminum to improve the casting qualities, is a soft and ductile alloy perfectly white in color, of the same general appearance as nickel plated work. It will buff to the same brilliant polish and retain its polish for a long time without lacquer, and the unpolished surface has the dead white color common to all sand cast nickel plated surfaces. This is a very useful alloy where a malleable white alloy is required. It is whiter than 18 per cent German silver and, as before stated, when cast is soft and malleable, and bends easily. The writer has used it for small thin key blanks. The castings should be made a trifle thicker than the finished keys, to permit of their being rolled or hammered which tempers the metal, making it very stiff and rigid. A very slight amount of hammering will produce this change.

Cheaper Alloy.

A cheaper alloy with a yellowish cast can be made by adding to 15 pounds of the foregoing alloy 6 pounds of copper and 5½ pounds of zinc. This makes a good ordinary German silver.

Another alloy tried was patented some time ago as Webster's nickel bronze. A "hardening" is first made by melting 6 pounds of copper, 12 pounds of tin, 3 pounds of nickel and 1 of antimony. One and one-half pounds of this "hardening" are added to 20 pounds of copper and 20 pounds of zinc. This is supposed to be an imitation German silver and is supposed to be hammered and rolled readily, but it is hard and brittle and of no practical value.

Nickel and copper unite to form many useful alloys. The so-called German silver is merely brass whitened by nickel and is in fact a true "white brass."

It may be taken as a rule that all white alloys possessing such qualities of brass as ductility, tenacity and malleability are alloys of nickel and copper, or triple alloys of nickel, copper and zinc.

Lead and aluminum are often added to these alloys. The former for the same reason that it is used in brass and bronze—to improve the machining qualities, and the latter to improve the casting qualities. Aluminum, however, makes nickel alloys "run dirty," as in the case of brass.

Nickel and Zinc.

Nickel and zinc alloys are of no commercial value, being brittle, although the zinc crystals are broken up.

The following alloys were tried:

(1) Zinc, 15 pounds; nickel, 1 pound; aluminum, 1 ounce.

(2) Zinc, 20 pounds; nickel, 1 pound; tin, 1 ounce.

These alloys are useful only as a medium of adding small quantities of nickel to other metals or alloys. In making them, half the zinc and all the nickel were charged together and the zinc was melted and brought to a flaring heat, being held at that point a few minutes until it had dissolved the nickel. When the balance of the zinc was added to cool the mixture, which was poured into ingots, the result proved that nickel has a negative value on alloys of zinc, commonly known as "white brass."

CARBORUNDUM MOLDS FOR CASTING ALUMINUM.

A new mixture for molds for casting aluminum has been patented by W. A. McAdams. The inventor appreciates the fact that aluminum or any other metal is rendered more dense when cast in a metal mold which conducts the heat away from the molten metal rapidly. Sand molds conduct the heat slowly. It is claimed that carborundum conducts the heat from the metal rapidly and gives a dense casting. For the mold a mixture of carborundum finely powdered, sugar and clay is used in the following proportions: Carborundum, 10 pounds; sugar, 12 ounces; clay, 10 ounces. The whole is mixed together with enough water to render the mass plastic and is then formed into the molds which are subsequently baked.

THE JOBBING BRASS FOUNDRY—III

A Comprehensive Presentation of the Mixtures Utilized in the Jobbing Shop

BY J. F. BUCHANAN

THE manufacturing brass founders have their own particular mixtures, to which, in the ordinary routine of their business, they pin their faith. For whatever class of castings they manufacture they have discovered the formula which can be relied upon to give good results, and to that formula they adhere. It is thus standard alloys are made and remade. The small amount of difference shown, either in the actual mixtures or the analyses of various manufacturers for the selfsame alloy or castings, is really surprising. Take steam metal for example. Here we have the analyses of three different well-known manufacturers' globe valve body castings:

	Copper.	Tin.	Zinc.	Lead.	Iron.
1....	89.26	4.75	3.77	2.15	.07
2....	88.35	5.60	4.10	1.95	...
3....	87.32	5.00	4.55	3.06	.07

Standard For High Pressure Steam Valves.

These figures would indicate that a good standard for high pressure steam valves might be represented in the following formula: Copper, 88 per cent; tin, 6 per cent; zinc, 4 per cent and lead, 2 per cent. (Iron was the only impurity sought for in the above analyses, but it is probable antimony would show up also.) A ¾-inch diameter test bar of the last named composition gave the following results: Tensile strength, 30,000 pounds per square inch; elongation, 18 per cent in 10 inches; reduction of area, 17 per cent. The government standard in this class (copper, 88 per cent; tin, 10 per cent and zinc, 2 per cent) is a much stronger alloy, but is not so well adapted for the commercial production of the castings.

Outside of the government departments, time and tools wait for no man, but apart from that, the commercial grades of steam metal given above resist corrosion better than the government standard metal and meet the pressure requirements just as well. In addition, the saving effected in finishing, by increased speeds and the introduction of automatic tools on a softer and cheaper alloy is very considerable. We started out to deal with jobbing mixtures. but first and foremost, one is impressed with the fact that while manufacturers or specialty brass founders work closely together in the matter of alloys, jobbing brass founders do not agree that way.

Jobbing Foundry Requirements.

The jobbing brass founder is a metallurgical free lance. Certainly he has his favorite mixtures, but he is not tied to them like the manufacturing brass founder. Sometimes the customer says what he wants in the mixture, but as a rule, the order comes for so many castings to pattern in ..... (here is inserted a comprehensive list of adjectives describing the required metal). "Best-tough-hard-strong gun metal" is not an unusual description in jobbing foundry orders. The government standard already referred to is all these and more besides. Unfortunately, few jobbing orders can stand the price of that mixture. This is where the art of the mixer is displayed. The production of sound castings depends upon two things—good molding and careful melting methods. An indifferent molder sends only a portion of his output to the scrap bin, but a bad melter spoils the lot. His own labor, the molder's and very often the machinist's have to be added to the melting and other losses on the work. A careless melter, then, is insufferable, not so much because the work has to be done twice over, but because good, valuable material is sometimes rendered useless for the purpose of casting.

Melting Conditions.

Metals are sensitive elements. Temperatures affect them in many remarkable ways and the higher the temperature the more sensitive they become. The use of scrap metals is an important feature in jobbing brass foundry mixtures and for general work the advantages of "blend" and remelted metal are great, provided the mixer has some intelligent idea of the grades or composition of the scrap used. The chief difficulty is the maintenance of uniformity in the alloy produced from miscellaneous scrap. A regular mixture of new metals, varying from 25 per cent to 60 per cent of the total melt, is a sure method of correcting irregularities due to differences in the old metals. Nevertheless, many jobbing brass foundries manage to make regular and reliable alloys using only scrap metals. This requires skill, experience and the judicious grading of the metals, which can only be acquired by careful practice in mixing the various alloys. The trouble with most of the brass founders' alloys is the classification of old mixed metals for use in making up new mixtures. In a miscellaneous heap of old scrap, castings, chips or filings, there are many elements of danger. Aluminum, iron, antimony, sulphur and other impurities in the paint, grease or oxides adhering to the metals play havoc with the mixture unless precautionary measures are taken to neutralize them. Some deoxidizing agent, as cupro-manganese, or flux, as sodium (either the metallic element or in the form of ground green bottle glass) is desirable.

Use of Old Metals.

Unfortunately, the variations in the composition of the old metals, bought and sold as scrap, are not easily determined, and until the Brass Founders' Association determines the essential components and defines the limits of the constituents in brass, gun metal, steam metal, bronze, Babbitt, German silver, etc., a lot of guessing will have to be done to use up the scrap coming from the junk dealers or from sources outside of our own foundries. However, the jobbing brass founder's diet does not consist of scrap only. The scrap metals give

him the advantage in price and, up to a certain limit, more homogeneous alloys result from the admixture of old and new metals. That is about all that can be said in favor of the miscellaneous brass foundry scrap heap.

Mixtures For Working Up Scrap.

The following mixtures should give some idea of the methods adopted in working up scrap in the jobbing foundry mixtures. For a gun metal equal to the government standard already mentioned, a good, clean substitute may be made with copper, 20 parts; fine yellow brass, 8 parts; tin, 3 parts, the tin being added shortly before the metal is taken from the furnace. An approximate analysis of this sample gave copper, 86.37 per cent; tin, 9.76 per cent; zinc, 3.80 per cent, and lead, 0.07 per cent. This metal could still bear description as "Best-hard-tough-strong gun metal." Other substitutes containing more zinc or lead are often made, but they do not compare favorably with the genuine article. An excellent steam metal has copper, 66 parts; tin, 4 parts; lead, 4 parts, and yellow brass, 26 parts, according to the mixture book of a large manufacturer in England.

A table of jobbing brass foundry mixtures selected from various sources showing the use of scrap is given below:

Jobbing Brass Foundry Mixtures.

	Copper	Zinc	Lead	Tin	Yellow Brass	Cock Metal	Mixed Scrap Borings, etc.
Yellow Brass	63	36	1	..	..	..	..
Fine Brass	70	29	..	1	..	..	..
Engineers' Bush Brass	46	..	3	5	46	..	..
Cock Metal	53	..	7	..	40	..	..
Cock Metal No. 2	56	..	5	3	36	..	..
Steam Metal	60	..	..	3½	20	17	..
Steam Metal No. 2	60	..	..	5	..	..	35
Bearing Brass	15	..	6	9	70	..	..
			Antimonial Lead				
Bearing Brass No. 2	80	..	12	8	..	..	..
			Lead				
Red Metal	72	23	5	..	..	..	..
					Fine Brass		
Red Metal No. 2	..	..	4	..	90	6	..
					Yellow Brass	Nickel	
German Silver	..	..	1	1	80	18	..
German Silver No. 2	43	..	2	..	38	18	..
Gun Metal (Springs)	25	2	..	3	..	..	..
						Steam Metal	
Gun Metal (Hydraulic)	70	..	..	8	..	22	..
Bell Metal	80	..	..	17	3	..	..
Bolt Metal	14	1	..	1	..	..	..
Hard Brass	45	..	..	5	..	..	50
			Antimonial Lead				
Cheap Babbitt	7	..	56	37	..	..	..
Anti-Acid Metal	73	..	27	..	..	..	..
Brazing Metal	30	..	..	..	70	..	..
White Brass	..	30	..	..	70	..	..
Antifriction Metal	..	50	..	42	8	..	..
		Antimony	Lead				
Antifriction Metal No. 2	3	8	12	77	..	..	..
Antifriction Metal No. 3	4	12	40	44	..	..	..

The foregoing alloys are all reliable in practice, but they must not be confounded with the standard alloys approved by governments and scientific bodies for the special duties for which they are respectively recommended. For jobbing work, these mixtures are generally satisfactory and many others could be given showing a freer use of scrap metals, but it must be recognized that space can only be given to the most serviceable mixtures for general brass founding. It rarely happens that a formula or specification of the alloy required is sent to a jobbing foundry, although sometimes a test is made. As a rule some hint of the purpose for which the castings are required is given and that is all the foundryman has to guide him in selecting a suitable mixture.

Brass and Gun Metal.

Brass and gun metal are the two staple alloys of the brass founder, but these alloys have not yet been standardized by any authoritative body. Brass, the copper-zinc series, and gun metal, the copper-tin series, may be modified by the addition of other metals and still be grouped with the standard alloys. This yellow brass, which is essentially a copper alloy, may contain any proportion of zinc between 25 and 40 per cent and from 1 to 3 per cent lead or tin. Gun metal may have the tin content varying from 5 to 15 per cent, and zinc from 2 to 5 per cent. Innumerable mixtures suitable for all conditions of castings may be evolved within these limits. But the brass founder does not stop here. By adding certain new elements to the original mixtures he produces bronzes, high-tension alloys, non-corrosive metals, ornamental alloys, anti-friction metals, and malleable alloys.

Alloys.

Some examples of how the modern alloys may be reproduced for jobbing work should be of general interest.

Manganese-bronze.—Add from 5 to 8 per cent cupro-manganese and from ½ to 1 per cent aluminum to the ordinary yellow brass.

Phosphor-bronze.—Add from 3 to 5 per cent phosphor-copper to any good gun metal mixture (preferably without zinc in its composition).

Hydraulic gun metal.—The best grades are produced by adding from 3 to 5 per cent cupro-silicon to straight copper and tin mixtures, the tin content of which should exceed 8 and may rise to 14 per cent.

Aluminum-brass.—The tenacity and beautiful gold-like appearance of this alloy are well known. Ferro-zinc and aluminum-zinc in small proportions (say from 1 to 5 per cent of each) are added to the ordinary yellow brass mixtures, which must be free from lead.

German silver.—A good substitute for this alloy can be made by adding 10 per cent nickelumen to the yellow brass mixture. Finally, by using a handful of ground green bottle glass and black manganese oxide (MnO_2) as a flux and deoxidizing agent, the free use of old metals should not be attended with any great difficulty in the way of producing sound, serviceable castings. Elaborate mixtures are neither necessary nor advisable in the jobbing brass foundry, and the examples here given should meet the demands of a good mixed trade anywhere.

BRASS FITTINGS.

By C. Vickers

Question:—We would like to have a mixture suitable for brass fixtures, such as ells and tees, but cheaper than steam metal.

Answer:—Copper, 50 pounds; zinc, 8 pounds; lead, 3 pounds, and tin, 1 pound.

HYDRAULIC VALVES.

By C. Vickers

Question:—We have considerable trouble making hydraulic valves that are to withstand a pressure of 240 pounds. We find that some of them leak. We use 90 pounds of electrolytic copper, 5 pounds of tin and 5 pounds of phosphor-tin.

Answer:—You are using too much phosphor-tin. Try the following alloy: Copper, 90 pounds; tin, 8 pounds; 5 per cent phosphor-tin, 2 pounds. Melt under charcoal.

PATTERNS FOR REPETITION WORK—II*

Allowances For Draft—Arrangement of Gates, Runners and Risers—False Economies

BY E. H. BERRY

IT IS NECESSARY that draft toward the parting line be provided in all cases. A smaller draft is permissible when the pattern is lifted from the sand, as in the case of "reversible plate" patterns, "split" patterns, and the drag side of all other patterns, than when the mold is lifted off of the pattern, as in the cope-half of all except "reversible plate" patterns and "split" patterns.

If the draw is shallow, it is usually desirable to express the draft in degrees, but if the draw is deep, it is better to give dimensions for the top and bottom of the taper. In the first case a slight error in measuring the angle would not sensibly affect the dimensions of the piece, while a slight error in the dimensions might change the draft very considerably. In the second case the conditions are exactly reversed.

For those portions of a pattern which are drawn from the sand, the draft should never be less than 1 degree on a side, or 0.02 inch per inch, on a side. If possible it should be about 2 degrees on a side or 0.03 inch to 0.04 inch per inch on a side.

For those portions of a pattern from which the cope has to be lifted, the draft should never be less than 1½ degrees on a side, or 0.03 inch per inch on a side. If possible it should be about 3 degrees on a side, or 0.05 inch per inch on a side.

Arrangement of Gates, Runners, Risers, and Supporting Connections.

If any portions of the desired casting are very heavy, in comparison with the remaining portions, the gates should be arranged to feed into the heavy parts. The gates should usually be wide and thin so as to break off easily. If the casting is very light it may be necessary in addition to nick the gate. Care should be taken to leave a good fillet between the nick and the casting itself as shown in Fig. 26, in order to give a clean break at the nick.

To secure uniformity among the castings from any one card, it is desirable to card them all alike, as shown at the left of Fig. 27, and not half right and half left, or half at one end and half at the other, as shown in the same illustration. Shifting the gate or turning the pattern over may cause variations in the casting, due to the different feeding and cooling conditions. It may also give trouble during machining as the irregularities due to gating come at one point in some of the castings, and at another point in others.

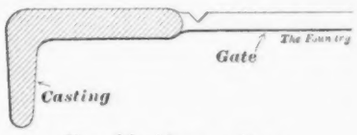


FIG. 26—NICKED GATE

To avoid "washing" it is usually desirable to locate the gate in such a way that it will not be in the direct line of flow through the runner. To effect this, the gates may either branch off of the sides of the runner, as in Fig. 27, or if this can not be done, an offset may be provided to check the rush of the metal as in Fig. 28.

Unless the pouring conditions are such as to require feeding the metal up into the mold from the bottom, the runner should be kept as high as possible, so as to get the best metal into the casting proper. This will usually involve putting the runner into the cope. An excellent cross section for the runner is shown in Fig. 29.

The draft on the sides is sufficient to give an easy draw, even though it is in the cope, and the section is heavy enough at all points to prevent danger of chilling. The section, flat on one side and curved on the other, which is sometimes used, should be avoided, as it is too thin at the edges. A rather neat expedient which sometimes proves helpful is the use of a diamond shaped runner as shown in Fig. 30. If the usual shape of runner had been used, as shown in Fig. 31, the incline at A would have been entirely too steep, and there would have been a very objectionable hanging pocket of sand at B

Risers.

Risers or shrink balls are required only in special cases to avoid piping or excessive shrinkage in heavy parts of the casting. As a discussion of the points at which they are necessary would lead into an entirely unrelated subject, they are merely mentioned here in passing as details which must be provided for when circumstances require them.

If the pattern is mounted in a vibrator frame, the latter should always rest on top of the mold board as shown in Fig. 32, and never be let down into it. As the surface of the mold board corresponds to the parting surface, the opening in the vibrator frame must be given draft away from the mold board as shown.

The connection between the pattern and the frame should in almost every case lie on top of the mold board, and should be connected to the frame somewhat as shown in Fig. 33.

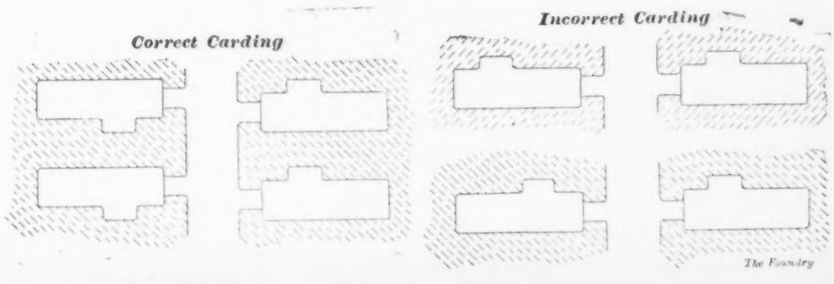


FIG. 27—EFFECT OF CARDING ON UNIFORMITY OF CASTINGS

*Presented at the annual meeting of the American Society of Mechanical Engineers.

In snap flask work, it may be necessary to resort to a band in certain cases. This has been treated in detail elsewhere in this article. If a band is placed in the cope it will clear the connection shown in Fig. 33, but if a band is needed in the drag, this form of connection would necessitate a notch in the band at the very point where the plugging of the hole left by the connection leaves the mold the weakest. To avoid this, the connection may be set into the mold board. This will permit the band to come down to the mold board, that is, extend up to the top of the drag, as shown in Fig. 34.

Pattern, Runner, Plate and Mold Board Material.

For patterns which are used sufficiently to prevent them from rusting, cast iron is by far the best material. It is not only cheap, but it meets the requirements of durability and lightness, and its surface, when free from rust and well waxed, gives a clean draw from the sand. If an iron pattern is out of use for any length of time, it is almost impossible to prevent rust spots, and these spoil the surface very quickly. Of course, the length of time in which an iron pattern may remain idle without rusting depends a good deal on the conditions under which it is stored, and the care taken in cleaning and waxing the pattern before it is put away.

If a mold board is used, it is usually desirable to keep the pattern and mold board together. When a wooden mold board is used, a very dry atmosphere shrinks and cracks, while even a moderate amount of humidity increases the liability of the pattern to rust. To avoid changes in the mold board the atmospheric conditions in the pattern storage must be made to correspond, as closely as possible, to those in the foundry. This may compel us, in the case of patterns used only at infrequent intervals, to resort to brass, bronze or other alloys, but all of these are heavier than cast iron and the sand has a greater tendency to stick to them. In the case of large patterns they may also be more costly, but in small patterns the possibility of using commercial shapes, which require little or no machining, may permit of savings which will more than offset the extra cost of the material.

Owing to the ease with which they can be soldered or brazed, the above mentioned alloys may sometimes be desirable for a costly pattern in which extensive changes are likely to be made.

Steel is no better than cast iron in the matter of rusting, and possesses little advantage over brass in weight or cheapness. It is not much used for patterns.

Aluminum is not very well suited for the pattern itself, as it is hardly durable enough, and sand has a tendency to stick to it. It is, however, the best material for plates, and for vibrator frames. If made from any other material their weight would be almost prohibitive.

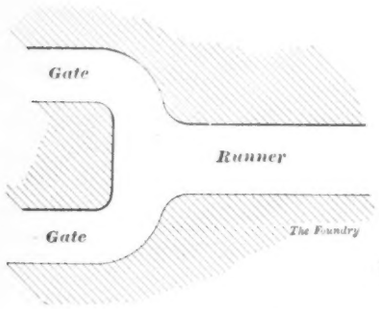


FIG. 28—OFFSET GATES

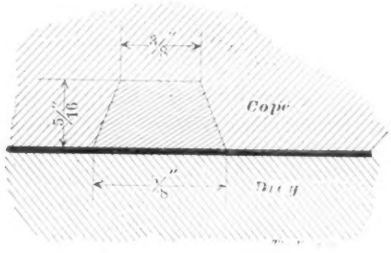


FIG. 29—CROSS SECTION OF RUNNERS

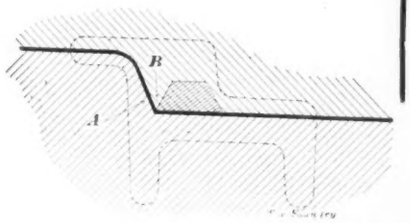


FIG. 31—UNDESIRABLE PARTING DUE TO SHAPE OF RUNNER

Wooden patterns are entirely unsuited for any but the roughest kind of repetition work. Even if the accuracy required is not very great, it will usually pay better to make metal patterns if a great number of castings is required.

For waxing metal patterns a liquid composed of bayberry wax cut with benzine until it is thin enough to apply with a brush, will be found very satisfactory. By painting with this liquid, a pattern can be waxed more quickly and evenly than by the usual process of heating and rubbing with beeswax. The bayberry wax also gives a superior surface as it dries on in a thin hard coat, free from the stickiness which frequently gives trouble if ordinary beeswax is used. Bayberry wax is used to some extent in pharmacy, and can be obtained from any drug store.

Points on Patterns Requiring Accuracy.

The importance of accuracy at different points on the pattern is indicated by the order followed in the list below:

A—Close clearance points at unmachined portions of the casting.
B—Locating points for the various machining operations
C—Unmachined surfaces which should bear a fixed relation to each other or to machined portions of the casting.
D—All remaining unmachined portions of the casting.
E—Machined portions of the casting.

The machined portions are placed last in the list because a slight variation in the amount of finish can be tolerated. The accuracy of the pattern at the points where no finish is allowed is far more important, be-

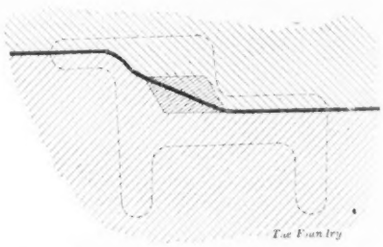


FIG. 30—GOOD PARTING OBTAINED BY USE OF DIAMOND SHAPED RUNNER.

cause the final dimensions of the casting depend entirely on the pattern. The locating points are also important, for if the castings from different patterns do not correspond at these points, variable results will be obtained from the machining operations.

Surfaces which are not machined, or which are used as locating points, should always be placed with reference to each other in such a way as to minimize the danger of incorrect spacing due to the possible cumulation of errors in measuring back and forth on the pattern.

Take for example a piece of the shape shown in Fig. 35. The surfaces marked *f* are to be machined, and the legs are to have a width C after machining. No special accuracy is needed for the distances E and F, as any slight variation will be corrected by the machining. On the other hand, if there are slight variations in G and H the errors might accumulate, and they might possibly be still further increased by slight errors in J, until the final width between

the unfinished surfaces might become greater or less than the desired value D. But as the outside surfaces are machined to the fixed distance A + 2B, the thickness C can not possibly come right unless D is right, and a small percentage of error in D would cause a considerable error in the width C. Many a case in which the wall of metal left after machining is entirely too weak, or in which the cutters fail to clean up a boss, or in which they dig in after milling the boss away entirely is due to disregard of these facts.

In entering each dimension care should be taken to make the number of decimal places correspond to the degree of accuracy required, in accordance with the method described in the first part of this paper.

Work to be Expended on Pattern.

The first item to be considered is the outlay on drawings, and there are really only two courses open to us. We can choose between making the drawings and not making them. We can avoid all unnecessary "frills" on

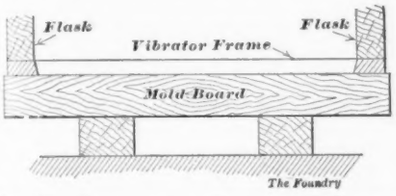


FIG. 32—DIRECTION OF DRAFT IN VIBRATOR FRAME

them, but if they are made at all, they should be complete and reliable. They should be omitted only in very unimportant patterns, or in the case of patterns which fall into the very lowest grades of the repetition class.

In the actual construction of the patterns there is more opportunity for grading the work to suit the requirements, and for devising means of producing the pattern quickly and cheaply. In planning the method of executing the work, we should consider, first the degree of accuracy required, and second the expenditure which will give the most economical relation between investment and earning capacity. Careful attention to the varying degrees of accuracy, indicated on the drawings in the manner already referred to, will enable all unnecessary refinements to be avoided, and with a little ingenuity, labor saving short cuts can almost always be devised.

The form of the pattern should be studied to determine whether to build it up, cut it out of the solid, make it from a casting which is machined all over or from a casting machined only at certain points.

In the case of built up patterns it is often possible to use commercial brass rods which require no finish, or to use bars of any desired cross section which can be milled to shape accurately and cheaply by means of fly cutters and then cut up as needed.

Many small patterns can be made from a solid bar of brass or cast iron more cheaply than from individual castings. If a pattern is of such a shape that it can best be produced from a casting, it may pay to make an accurately finished metal master pattern, castings from which can be finished up with the minimum amount of machining. Frequently the machining can be omitted altogether, the only finish required being a smoothing up with files and emery cloth, or certain spots may be machined and the balance smoothed up. Of course, in making castings for this purpose care must be taken to avoid excessive rapping and to use a fine sand which will give the smoothest

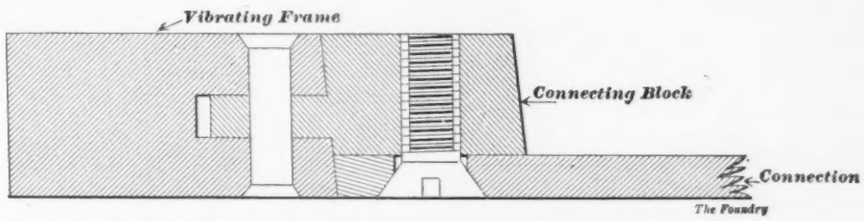


FIG. 33—SUPPORTING CONNECTION FROM PATTERN TO VIBRATOR FRAME

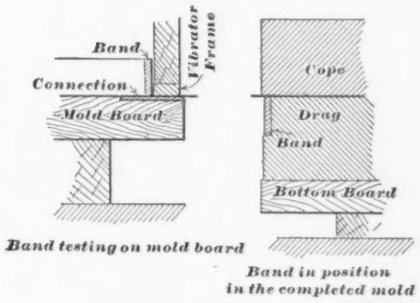


FIG. 34—METHOD OF PROVIDING FOR A BAND IN THE DRAG

possible surface. To avoid errors due to hand molding it may also pay to mount the metal master pattern for temporary use on a molding machine.

The relation between working patterns, master patterns and grand master patterns can perhaps be brought out most clearly by quoting the following rules which the author drew up some years ago, and which have been followed since that time with good results:

Rules.

All patterns will be classed under one of the three following heads: *a* Working patterns. *b* Master patterns. *c* Grand master patterns.

Working patterns used for *repetition work* shall be of metal, and in most cases mounted for use on the molding machines.

Working patterns used for *experimental work*, or for *jobbing work* shall be, in most cases, of wood. When practicable, they shall be arranged for temporary mounting for use on the molding machines.

Master patterns may be of wood or metal, according to circumstances. When the piece to be produced permits, the working patterns shall be made by smoothing up castings taken from a metal master pattern. In cases in which it is preferable to machine the working patterns, the master pattern usually shall be of wood.

Grand master patterns shall be of wood, or if made of metal shall be built up out of stock material. They shall be used in cases where it is necessary to obtain a casting out of which to make a metal master pattern.

Excepting in special cases, for which special provisions are made, the following general instructions shall be observed in making patterns and in making drawings for them.

Metal Working Patterns.

Metal working patterns are the standard patterns for repetition work.

They are *made from drawings* showing the finished dimensions of the pattern itself. These drawings will be dimensioned to cover all necessary allowances for finish, shrinkage, and draft, and there will be no further allowance in making the pattern.

They are *made by* smoothing up castings obtained from the metal master pattern, or by machining castings obtained from the wooden master pattern, or by building up out of stock material.

They are *mounted* for use on the molding machines in accordance with the carding drawing.

They are *stamped* on the runner with the part number of the first piece produced from this casting. If one casting is machined to make several different pieces, the pattern will still have only one pattern number, which will be identical with the part number of the first piece produced. Each card will have a distinguishing mark, usually one dot on the first card, two on the second, etc., which will be placed so as to be visible in the casting even after it is machined. This mark will be in each pattern of the card, and alike in all patterns of any one card. Even if there is only one card, the distinguishing mark is to be put on it, as another card might be made later.

Wooden Working Patterns.

Wooden working patterns are the standard patterns for experimental or jobbing work.

They are *made from drawings* showing the finished dimensions of the piece. The pattern must, therefore, be made with allowance for single shrinkage, draft and finish, as noted on the drawing.

They are *mounted* for use on the molding machines whenever practicable.

They are *stamped* with the pattern number, which corresponds to the number of the finished piece. If one casting is machined to make several different pieces, the pattern will still have only one pattern number corresponding to the number of the first piece produced from it.

Particular attention is directed to the fact that patterns for runners fall under this heading and must comply with these requirements.

Metal Master Patterns.

Metal master patterns are used to obtain castings suitable for use as working patterns after they have been smoothed up, or used in cases in which a wooden master pattern would not be durable enough.

They are *made from drawings* showing the finished dimensions of the metal master pattern itself. These drawings will be dimensioned to cover all necessary allowances for finish, shrinkage and draft, and there is to be no further allowances made when making the pattern.

They are *made of* castings obtained from the grand master pattern, or by building up out of stock material.

They are *mounted* temporarily for use on the molding machines to facilitate the obtaining of good castings.

They are *stamped* with the pattern number.

Wooden Master Patterns.

Wooden master patterns are used in cases in which the metal working pattern has to be machined.

They are *made from drawings* showing the finished dimensions of the metal working pattern. Allowance for single shrinkage, and an additional allowance for finish all over must be provided when making the pattern.

They are *mounted* temporarily for use on the moldin~ machines when practicable.

They are *stamped* with the pattern number.

Grand Master Patterns.

Grand master patterns are needed only in cases in which a metal master pattern has to be made out of a casting.

They are *made from drawings* showing the finished dimensions of the *metal master pattern*. Allowance for single shrinkage and an additional allowance for finish, as marked on the drawing, must be provided when making the pattern.

They are *mounted* temporarily for use on the molding machines when practicable.

They are *stamped* with the pattern number.

The distinguishing mark on each pattern which is referred to in the rules above quoted is provided for the purpose of identifying the card from which a given casting was produced. This is a necessary feature if duplicate sets of patterns are run.

In discussing the flask sizes, reference has already been made to the use of a few patterns in a small flask for such patterns as would not warrant a larger pattern equipment. And even if a smaller flask is not practicable or desirable, it may often pay to make and card only a few patterns, leaving the balance of the mold unused, in preference to spending money in the tool room which the saving in the foundry might not offset in years.

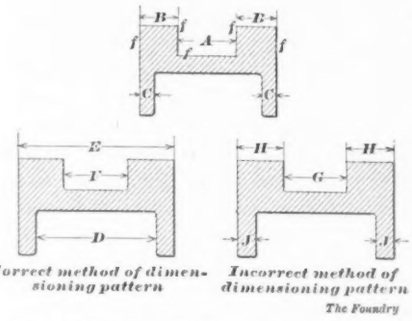


FIG. 35—ARRANGEMENT OF PATTERN DIMENSIONS

When undertaking new work it is always a wise precaution to make and card only a part of the patterns, leaving the balance to be added later so as to facilitate the making of any changes or improvements which may suggest themselves in turning out the first few lots.

In the same way, if it is desirable to put through a limited number of castings from a new pattern to test out the tool equipment, much valuable time can often be saved by getting the castings as soon as a single pattern can be made and carded. The remaining patterns of the card can be added later.

If a portion of the mold is unused, do not spread out the patterns. Card the ones which are nearest to the sprue, and keep them close together to avoid waste of metal in the runner.

False Economies.

It is usually false economy to mount two or more different patterns on one card. Even if it seems that the proportion in which they will be used can be definitely fixed, for instance in the case of rights and lefts, unforeseen circumstances may arise at any time to upset the calculation. Repair orders may be heavier for one casting than for the other, or a batch of work from one casting may be spoiled and have to be scrapped, or the loss in the foundry or in the factory may be heavier for one than for the other. These and similar conditions may make it necessary to increase the output on one of the castings, and this is always troublesome and wasteful if different patterns are mounted on a single card.

WAX FILLET MACHINE

BY A. B. C.

IN A LARGE number of foundries wax fillets are used for venting purposes, and a simple and handy machine that can be easily built, as well as a spool for holding the fillets, are shown in Figs. 1, 2 and 3. The wax tube, Fig. 1, is made from 2¼-inch pipe having a screw flange on one end, while the opposite end is round. The frame has a base plate and a hub through which a hole is drilled to receive the nut for the screw. The base plate has an opening to allow castings A and B-B to pass through, which permits the flange to rest on the base. The plunger C is secured to the upper end of the screw and a hand wheel is also attached. An enlarged view of the flange end is shown in Fig. 2. A number of castings, as shown at A, 2½ inches square and 1¼ inches thick, are made and drilled as shown. The small hole D is drilled to the size of the fillet. The small castings B-B are ¾ inch by 2 inches, and are provided to receive the casting A. To change the size of the fillet the bolts through B are released, and the casting A is removed and any

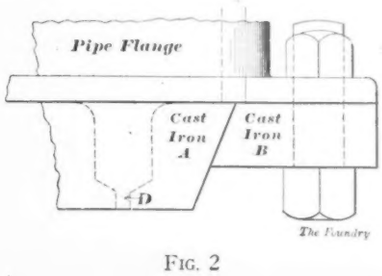


FIG. 2

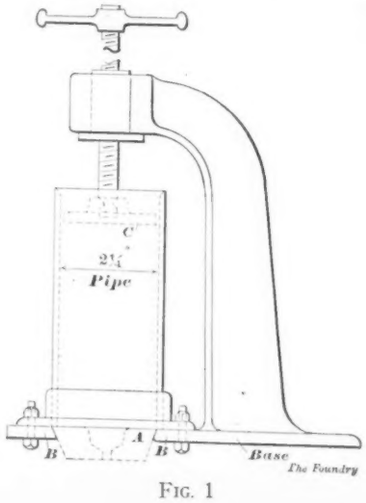


FIG. 1

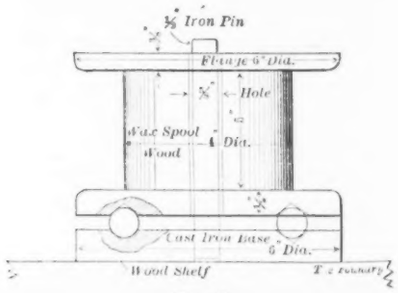


FIG. 3

size substituted as required. To fill the tube with wax, the plunger is drawn out, the base plate lifted off and the tube can then be easily filled. Before filling the tube, it should be inserted in hot water, and if the same is not at hand, after it has been filled and readjusted to the base plate, it should be heated with a gasoline torch until the wax is warm enough to force it through the opening D. These tubes can be made any desired length, the one shown being 10 inches long and 2¼ inches in diameter.

A handy holder for fillets is shown in Fig. 3. It is a waste of time, labor and material to wind the fillets on a stick, or to leave them piled in a heap. This spool is made of maple and has a ⅝ inch hole through the center. The cast iron base plate has a ½ inch iron pin secured to its center and V grooves are turned in the bottom of the spool and in the top of the base plate. The spool revolves around the ½ inch pin and on one ½ inch steel ball. The iron base plate prevents shifting when removing the fillets, and the ball causes the spool to revolve freely, thus preventing the fillets from breaking into small pieces. Each spool is numbered with pattern figures.

"BURNING ON" IRON INSIDE OF A STEEL RING

BY J. G. BROWN

EVERY patternmaker and molder has undoubtedly had considerable experience with the casting of a body of hot iron on the outside of a cold shaft, pipe or other section. The solution of the reverse problem is shown in Figs. 1 and 2, namely, the casting or "burning on" of molten iron on the inside of a steel ring. The work is by no means complicated, but is interesting in view of the fact that it is just the reverse of a class of work frequently presented.

In Fig. 1 is shown a section through the center of a flask and pattern of a plain spur gear blank, with a large hub, to which is cast a steel ring which is later machined and cut into a gear. The wooden pattern is constructed in the ordinary way. When molding, the pattern is placed on the parting board with the ring end, B B, up. The drag is then placed in position as well as the steel ring BB, as shown. The drag half of the flask is now ready for the sand, and after ramming is rolled over and the cope is rammed up in the usual way. The cope is then removed and the pattern is withdrawn, leaving the steel ring in the mold. The core, which is one of the most important features of this job, is made as shown by the dotted lines. C C is the body of the core, and D D is a hole extending through the center terminating at X. A series of holes E E, 5-16 of an inch in diameter, are made through the walls of the core. The upper or cope end of hole D in the core is made bell shaped, as is also the sand over hole D through which the metal is poured.

F F is the overflow, which is another important feature connected with this work. It will be seen that a gutter shaped sand heap is made on top of the cope, as shown by the dotted lines extending from the hole in the cope out to the side of the flask. The metal is poured through the hole D D in the core, is retarded at X and flows through the holes E E, which directs the hot metal against the cold steel ring B B, thus filling the mold until the metal overflows at F F and runs down the side of the flask into a pocket of sand. The pouring does not cease when the metal appears at the overflow and is continued until 20 to 25 pounds flows into the sand pocket at the side of the flask. When this amount of metal has run over, the steel ring is almost brought up to the melting point owing to the action of the hot metal, and expansion has taken place equal to that in the liquid iron. Consequently, when cooling occurs, there is an equal contraction, throughout which period the cementation or "burning on" occurs.

In this particular piece of work about 12 pounds of iron were required, although about 35 pounds were used for each casting, and from 4,000 to 5,000 are made each year.

The method of securing the ring while machining is shown in Fig. 2. G is the ring and H H are machined grooves on the inside about ⅛ of an inch deep by 3-16 of an inch wide. I I I are cross recesses connecting H H.

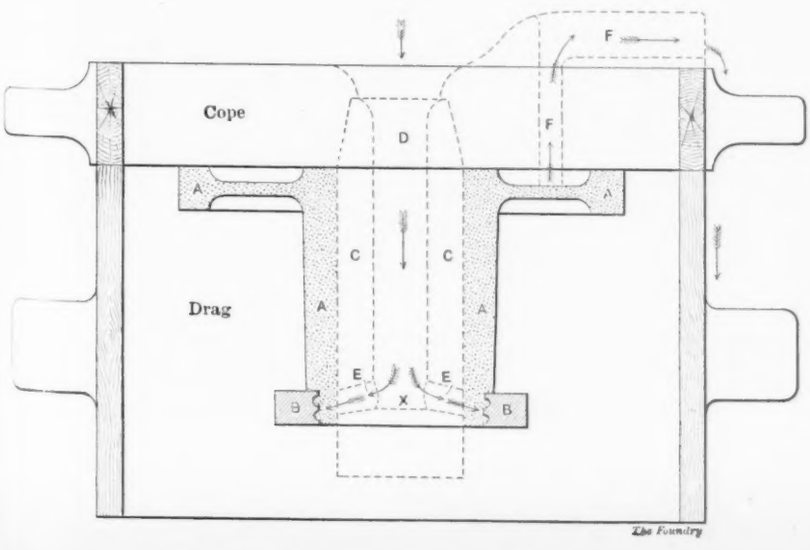


FIG. 1—SECTION THROUGH CENTER OF PATTERN AND FLASK

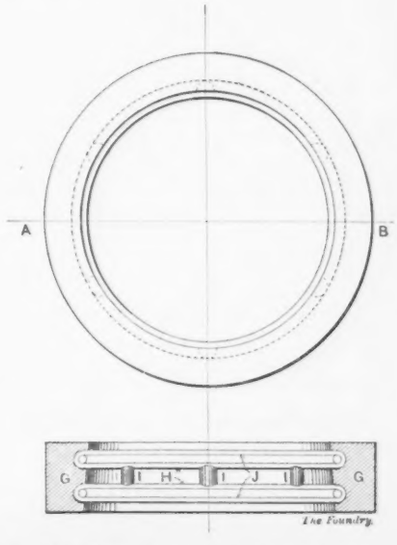


FIG. 2—STEEL RING AND SECTION THROUGH A B

A MODEL JOBBING PATTERN SHOP

New Plant of the Balkwill Pattern Co., Cleveland—Novel Arrangement of Tools

DESIGNED and equipped to afford the best facilities for the production of patterns for the jobbing trade, the new shop of the Balkwill Pattern Co., Cleveland, is a model plant of its kind. The building, a 2-story brick structure of heavy mill construction, is well lighted and ventilated. Two rows of windows on all four sides flood the shop with light, and all of the large machines are connected with an exhaust system that carries off the dust and shavings.

The pattern shop is located on the ground floor, the second story being utilized for the storage of lumber. An elevator, with a cage of large dimensions, is used to carry material from stock to the floor below. The building, which is 68 x 120 feet, has a heavy foundation to support additional floors if necessary.

General Arrangement.

As shown in the ground plan, Fig. 1, the benches extend half the length of the building on either side, and as the patternmakers face the light, the lower sashes of the windows are of opaque glass.

All of the tools have been located at one end of the shop, an arrangement which has proven not only convenient but economical as well. When cutting up lumber for a job, the patternmaker can dress his material in a confined space and is not compelled to walk from one end of the shop to the other to perform the various operations as is the case when the machines are scattered over the floor. The shafting required with this layout has also been reduced to the minimum. The equipment of tools is unusual for a plant of this size and includes the most modern circular and band saws, sand paper machines, planers, jointers, lathes, etc. The pit lathe shown in Fig. 3, used for turning the faces and rims of large gears has a capacity for wheels up to 13 feet in diameter. Six face plates are provided for the various sizes which are fastened with screws to the base plate shown. When not in use the pit is enclosed with a suitable cover.

The exhaust system which connects all of the large machines as shown in Fig. 7, is operated by a small fan that carries the dust and shavings to a bin outside of the building. It is elevated a sufficient height above the ground to permit wagons to pass underneath and discharges by gravity.

Store Room.

All of the small supplies, including nails, sand paper, fillets, etc., are in charge of a storekeeper who likewise does the varnishing and attends to the shipments. The supplies are neatly arranged, Fig. 4 showing the bins with division for the various sizes of nails, boxes for the leather and wooden fillets and a roll of sand paper supported on a rack. Power is generated by a 35-horsepower gas engine and the plant is heated by steam from a low pressure boiler, overhead coils being used.

This concern was established about 1875 by S. Balkwill, now retired, and was operated by his son until 1900, when the plant was taken over by W. S. Wellman, formerly connected with the Wellman-Seaver-Morgan Co., Cleveland. As the business developed it became necessary to seek larger quarters and a new corporation was organized for the purpose of erecting a new shop. The officers of the company are W. S. Wellman,

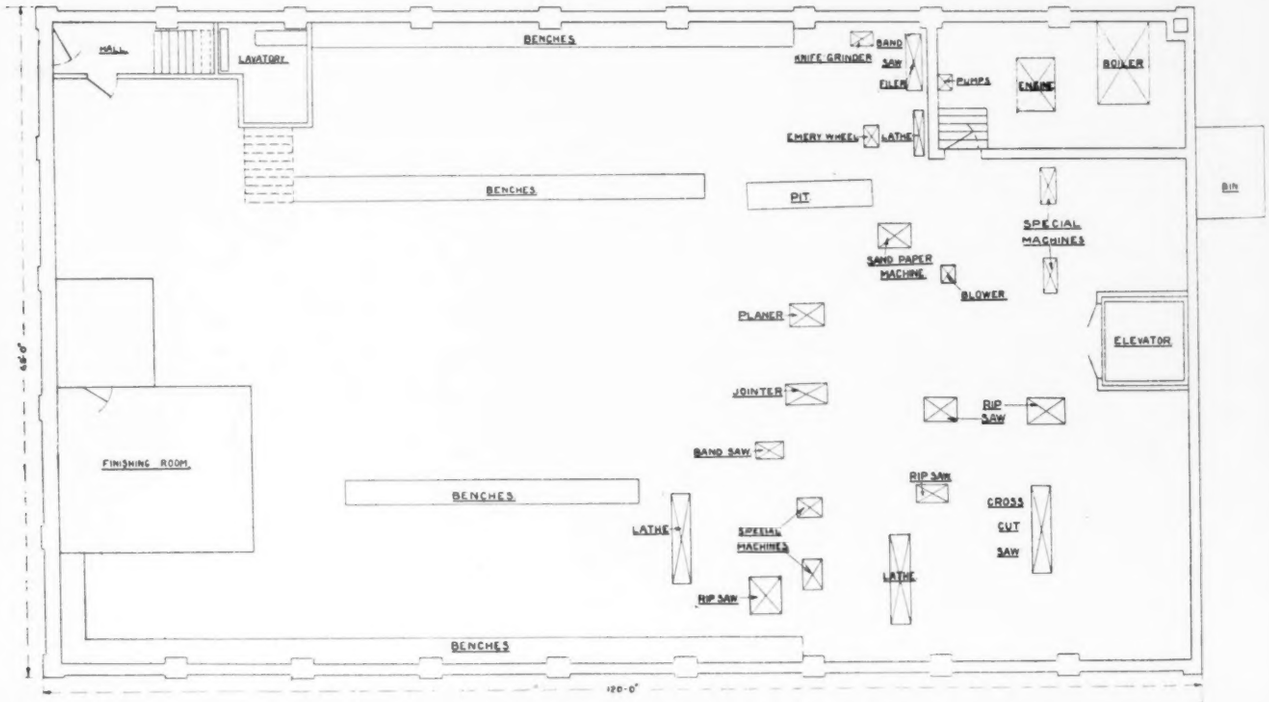


FIG. 1—LAYOUT OF THE PATTERN SHOP OF THE BALKWILL PATTERN CO.

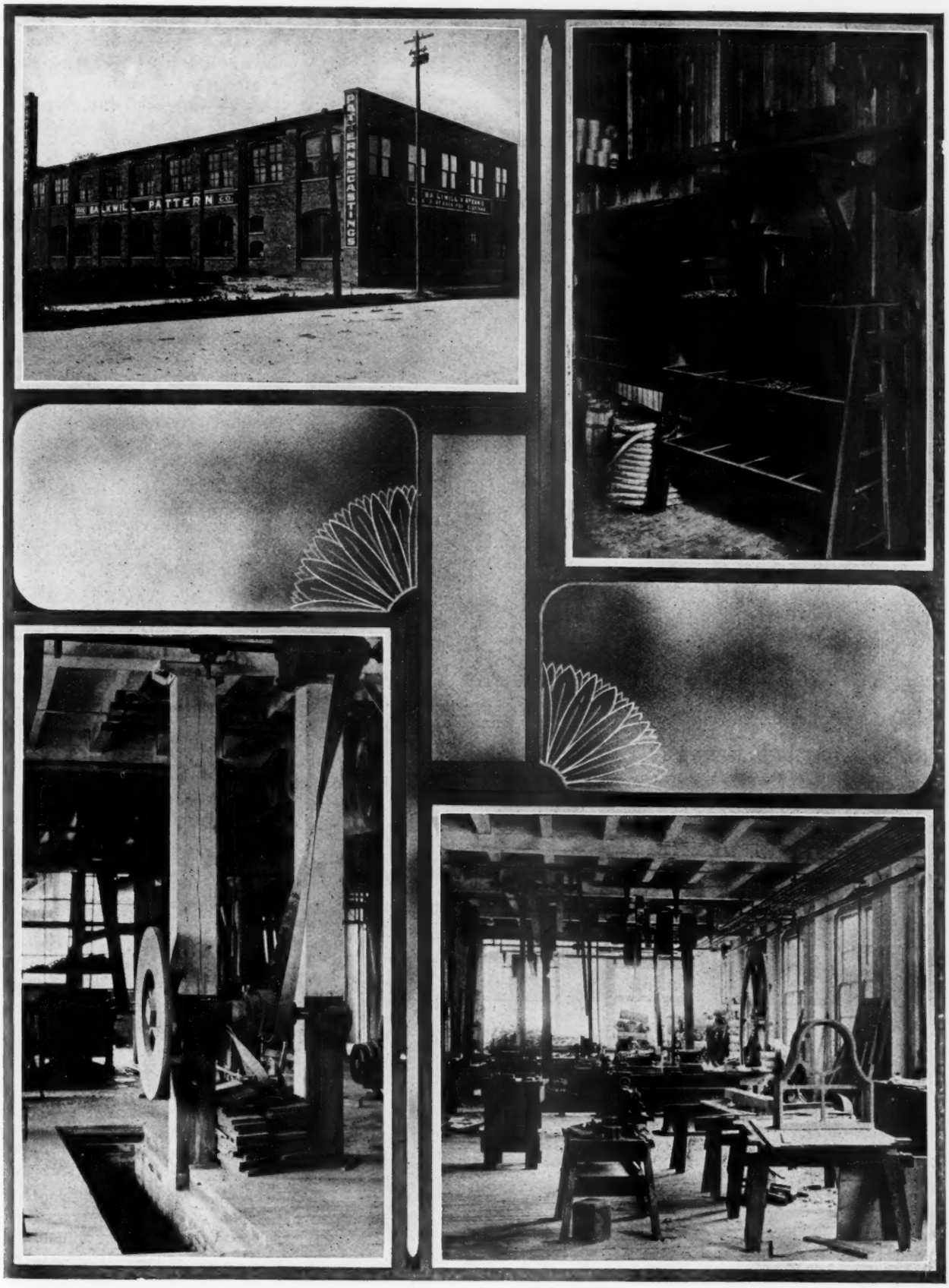


FIG. 2—VIEW OF THE PLANT OF THE BALKWILL PATTERN CO.
FIG. 3—PIT LATHE FOR LARGE GEARS

FIG. 4—A CORNER OF THE STORE ROOM
FIG. 5—SECTION OF THE PATTERN SHOP SHOWING LARGE LATHE IN THE FOREGROUND

FIG. 6—SECTION OF THE PATTERN SHOP SHOWING EXCELLENT LIGHTING FACILITIES

president; H. G. Wellman, secretary, and N. C. Irwin, superintendent.

A specialty has been made of small complicated pieces as well as working models of machinery, while every facility has been provided for producing large patterns. The plant is located on East Forty-ninth street in the center of Cleveland's manufacturing district.

EXPOSITION OF FOUNDRY EQUIPMENT.

The Associated Foundry Foremen of Chicago and vicinity have decided to hold an exhibit of foundry equipment at the Lewis Institute, Madison and Robey streets, Chicago, which will continue for a period of three days, from March 5 to 7. The first exposition of this kind held by this organization last year continued through an afternoon and evening and was attended by more than 600 foundrymen. Already a large number of manufacturers have signified their intention of showing their product and the success of the venture is assured. Complete arrangements for exhibits can be made by addressing the secretary, C. E. Hoyt, Lewis Institute.

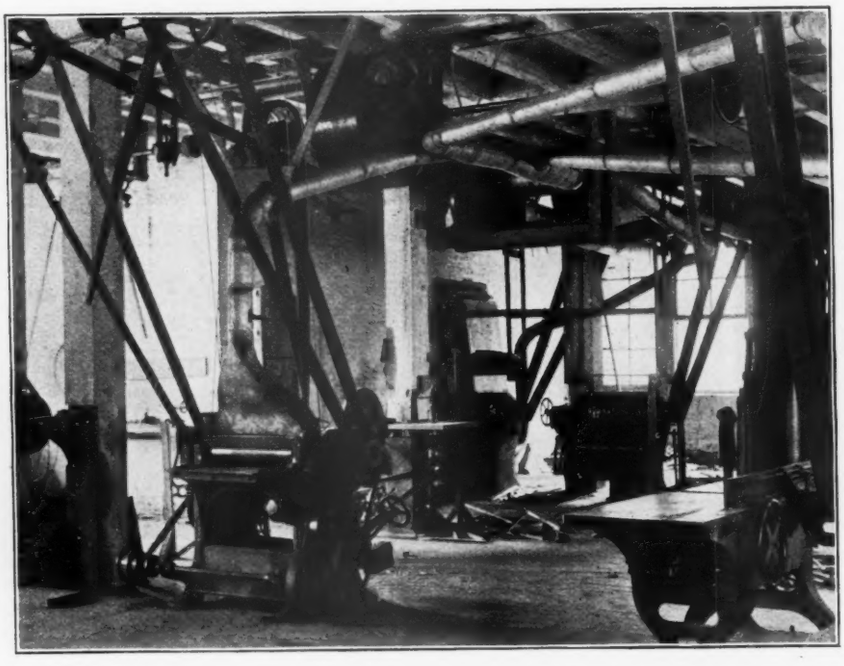


FIG. 7—EXHAUST SYSTEM WITH VARIETY TURNING MACHINES IN THE BACKGROUND

PERSONAL.

W. J. Legg, vice president of the Associated Foundry Foremen of Chicago and vicinity, and until recently superintendent of the foundry of the Featherstone Foundry & Machine Co., Chicago, has taken charge of the foundry of the American Car & Foundry Co., Buffalo.

Alex M. Thompson, for many years superintendent of the foundry of the Link Belt Machinery Co., Chicago, has severed his connection with that concern.

Herman A. Becker, formerly superintendent of the foundry of H. W. Caldwell & Son Co., Chicago, has resigned and is now connected with the Root & Van Dervoort Engineering Co., East Moline, Ill.

W. A. Bole, superintendent of the Trafford City foundries of the Westinghouse Machine Co., Pittsburg, has resigned.

S. S. Knight, who for the past two years has been superintendent of the plant of Abendroth Bros., Port Chester, New York, and manager of the Huntington, W. Va., shop of the Globe Foundry Co., of Port Chester, has resigned to accept the position of manager of the Chester Steel Casting Co., Chester, Pa.

S. Owen Livingstone, who had charge of the advertising and foreign sales departments of the Fox Machine Co., Grand Rapids, Mich., has severed his connection with that concern and has been placed at the head of the sales and advertising departments of the Wilmarth & Marmon Co., Grand Rapids, manufacturer of drill grinders, loose pulleys, friction countershafts, etc.

E. Ronceray, of the firm of Ph. Bonvillain & Ronceray, Paris, France, returned to Paris about the middle of December. Mr. Ronceray was in this country about seven months in the interest of his universal method of machine molding.

William Nokes has resigned his position as superintendent of the brass foundry of the Western Tube Co., Kewanee, Ill., to accept a similar position with the Detroit Stoker & Foundry Co., Detroit.

Andrew Schiefer, formerly superintendent of the Massillon Iron & Steel Co., Massillon, O., has been made superintendent of the Dimmick pipe plant, Birmingham, Ala.

Frederick W. Smith, for several years vice president and general manager of the United States Radiator Co., Dunkirk, N. Y., has severed his relations with that company.

METHOD OF MOLDING LARGE BED PLATE

Drag a Permanent Fixture—Standardized Practice—Pouring Arrangements

BY W. W. McCARTER

THE METHOD employed in making the bed plate for an anti-friction pulverizer as pursued in our plant can be classed as a foundry standard. Not a single casting has been lost up to the present time, although 114 have been made. To standardize in the full meaning of the term, as applied to foundry practice, means to simplify a method by which permanent economies may be obtained, and in this instance the drag of the mold is a permanent fixture after it has once been placed in position, as shown in Fig. 7. The question of its permanency will not be discussed here, but will be taken up in the regular order.

Plan and inverted views of the castings are shown in Figs. 1 and 2. Fig. 3 is a section on the line AB, and Fig. 4 is a section on the line CD. Fig. 5 is the plan of the plate pattern. Fig. 6 shows the pattern dismembered. Fig. 7 is a longitudinal vertical section of the flask containing the casting. Fig. 8 is a section of the drag indicated by the arrows in Fig. 7, and Fig. 9 is an end and inside view of the drag showing the sweep, plate and apron and the movable panels.

Method of Molding.

Assuming that one casting has been made, the molds for the other section are made in the same manner as the first, with the exception of the molding of the drag, which consists of a bottom board, anchor plate A, Fig. 10, and the cope vent conduits. The ring B, Fig. 6, which has four marks at right angles across the diameter that correspond to similar marks on the joint of the drag, is bedded-in in the lower part of the pattern. This ring is bedded-in in the drag two inches below the joint, and as the plate pattern is two inches thick, a sweep of that depth is employed. As shown at CC, Fig. 8, this is a double sweep and is made of light iron having riveted joints, with a spindle riveted to the center, the radius of which exceeds half the square of the plate pattern.

The center rod on the anchor plate A, Fig. 8, has a sleeve socket I, which is fastened with a set screw. The spindle on CC enters this socket and the double sweep is revolved, clearing the anchor rods and sweeps up a surface equal to its radius flush with the upper surface of the ring B. The sweep CC is then lifted from the socket and is swept longitudinally, traveling on the joint of the drag a distance sufficient to sweep out the surface to be occupied by the four corners of a plate pattern, D, Fig. 6, which is then set upon the surface just swept out by CC. Long dowel pins passing entirely through this part of the pattern fit in the ring B. The plate is then telescoped on the pins and is guided to its proper position in this way. A hammer and block is employed for rapping it down at each corner where it rides upon the core prints and pads, and the narrow lugs or strips at the center.

Castings Without the Apron.

Fig. 6 shows a side view of the entire pattern dismembered. Some of the castings are made without the apron E, when the plate assumes the form of a square and to accommodate this in the same flask, the bar in the cope Fig. 7, is let down flush with the joint, and the gates are moved one space nearer the pattern, while the cope is rammed up only as far as the bar. The majority of these castings were however made with the apron, the sweep G, Fig. 9, for producing it being shown in position on the drag. An end and inside view of the drag is shown in broken section. The purpose of these views is to show the application of the sweep G in securing the oblique angle of the pad on the apron, the thickness of which is first swept out.

The panels 1 and 2, on either side of the drag at the joint are removed by taking out the two wood screws. The thickness of the panels is equal to that of the pad, and the sweep has a depth equal to the thickness of the plate or apron. The depth of the plate is first swept out and the two panels are removed and the sweep G is inverted.

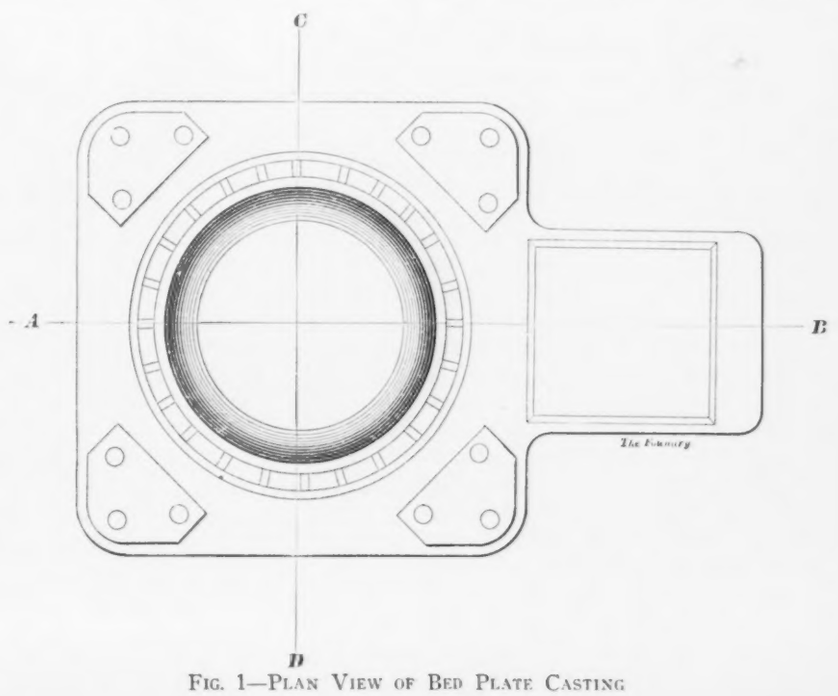


FIG. 1—PLAN VIEW OF BED PLATE CASTING

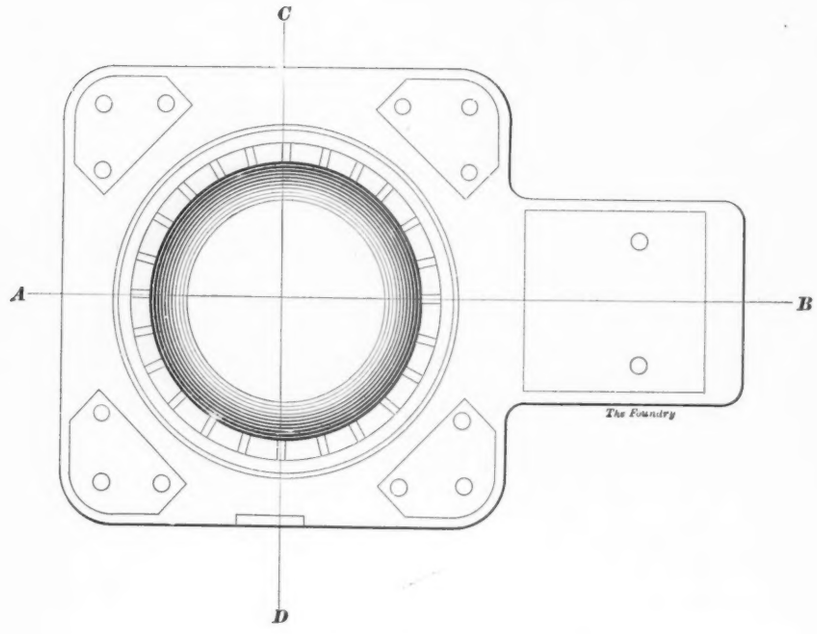


FIG. 2—INVERTED VIEW OF CASTING

The guide of the sweep is kept against the outside edge of the joint in its longitudinal movement along the side of the drag. In this way the oblique angles of the bed are obtained, as well as its depth. The panels are then replaced, and the apron E is set into place, being matched with the marks that are shown in the pattern, and hammer and block are then used for rapping it down when it rides on the two round core prints underneath. The joint is made, and so far as this part of the job is concerned, it is ready for the cope.

Bedding-in the Segments.

The bedding-in of the segments, H, Fig. 5, follows. Each of the segments has two loose dowels by which they are placed and maintained in their proper position while they are being tucked in. There is also a shoulder or lip on the plate pattern, Fig. 6, which further insures the maintenance of the segments in their proper positions. After the dowel pins have been removed, the top part of the core which is to be swept up on the ends of the anchor rods on plate A, Fig. 10, is made. The sleeve socket I, which the spindle of the sweep CC entered when that sweep was used, is again pressed into service. The anchor plate A, as shown in Fig. 7, contains the coke bed. Heap sand is tucked and rammed about the rods and the cope vent is continued to within two or three inches of the ends of the rods. Facing, 1 to 9, owing to the peculiarity of the local sand, is then tucked within the range of the sweep K, Fig. 10.

The sweep K is shown in position in Fig. 10, and as soon as the cap which hugs the spindle J is fastened, the operation of sweeping up the top part of the core can be proceeded with. Either set screw may be slackened up and the spindle raised slightly by a light blow with the hammer, in case the sweep comes in contact with the pattern. When the top part of the core has been swept up, the sweep K, spindle J, and socket I, are removed by slacking off the lower set screw from the center rod. The center part of the core is then filled with a handful of small coke which is dropped into the place previously occupied by the socket and is tucked over with heap sand and consequently the surface upon which the top part of the pattern is to rest is faced. After this is done the pattern just referred to, shown in L, Fig. 11, is placed in position over the core which has just been finished.

Cope.

The cope is then set in position, and the gate pins are adjusted, one on either side of the apron, and two risers are placed at opposite ends

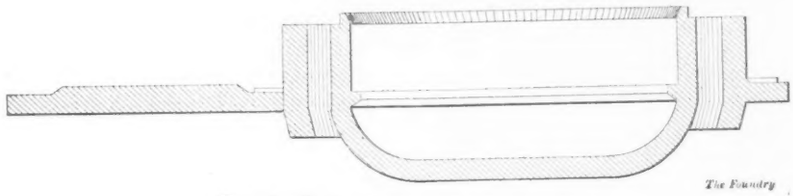


FIG. 3—SECTION ON THE LINE A B

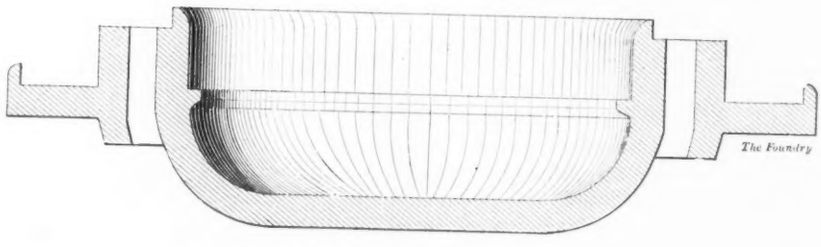


FIG. 4—SECTION OF THE LINE C D

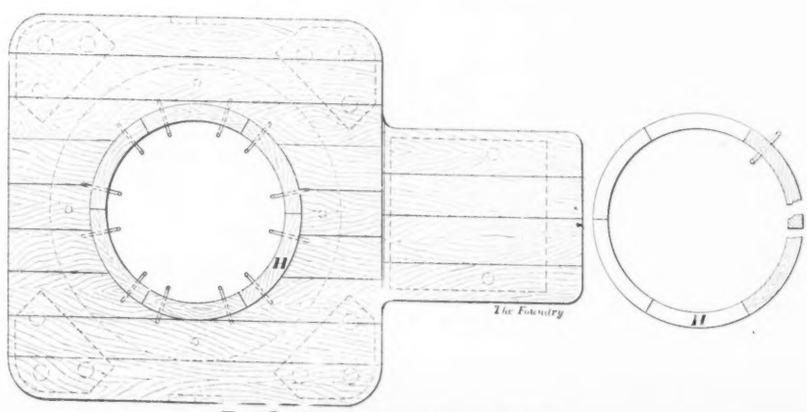


FIG. 5—PLAN OF THE PLATE PATTERN

near the corners. The bars are then tucked and the cope, after being rammed, is vented and lifted off, bringing the top part of the pattern L with it. The pattern L is then withdrawn from the cope and the plate D and apron E are withdrawn from the drag. The segments H are drawn in and then out, the ring B following.

After the mold has been retouched and finished, the cores are set. Taking the vents through the cope is, of course, included in finishing in this particular case. A vent rod is also pushed through the bottom print and this is filled with parting sand to prevent the possibility of the metal entering the print in the shape of a fin and filling the vent in the core or its seeking an outlet to the bottom board.

There are 24 dry sand cores, M, Fig. 12, which are used in coring out the inner walls of the circular portion of the casting. Each core enters its respective print at the bottom, while at the top a continuous circle is formed. The joints between them at the top print being disposed in the direction of the radius, they are set by a gage a certain distance from the green sand core which was swept up by the sweep K. The inclined keystone position of this continuous circle renders the entire set as rigid as though they were all made in one core and set into the mold as such when the cope is closed down over them.

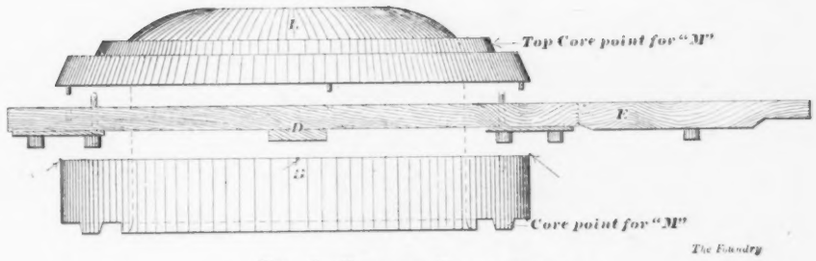


FIG. 6—PATTERN DISMEMBERED

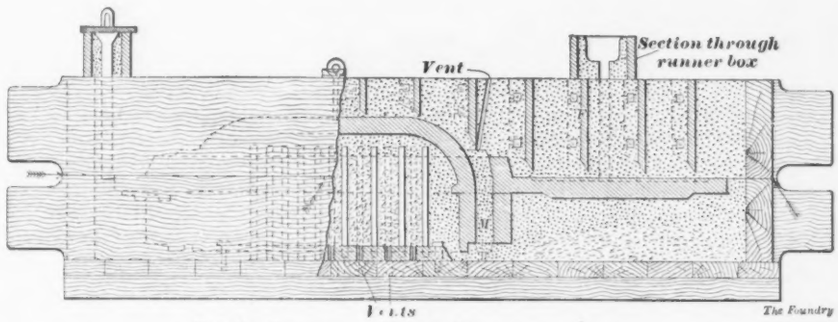


FIG. 7—SECTION OF FLASK CONTAINING CASTING

Pouring Arrangements.

After the cores have been set and the gates and risers cut, the cope is closed down and the mold is ready to receive the metal. The runner box, shown in Fig. 7, is a section through one of the pouring gates. There are two pouring gates to which the pound in this runner box is built, one on either side of the apron, four heavy sprues being cut into on each side of the latter. When filling the mold, the metal is poured into one end of the runner, flushing it, and the flow of metal from the ladle is then diminished sufficiently to insure a steady stream, and at the same time to avoid the disagreeable contingency of a burn-down, which may occur if the gates should suck on account of an insufficient flow of metal through the ladle.

Regarding the permanency of the drag, it can readily be seen that the cope vent conduits and the anchor plate support upon the substantial bottom board, as shown in Fig. 7, remains in position until all of the castings have been made. The arrow points at the joint of the drag indicate the marks by which the ring B is bedded-in as if by a template.

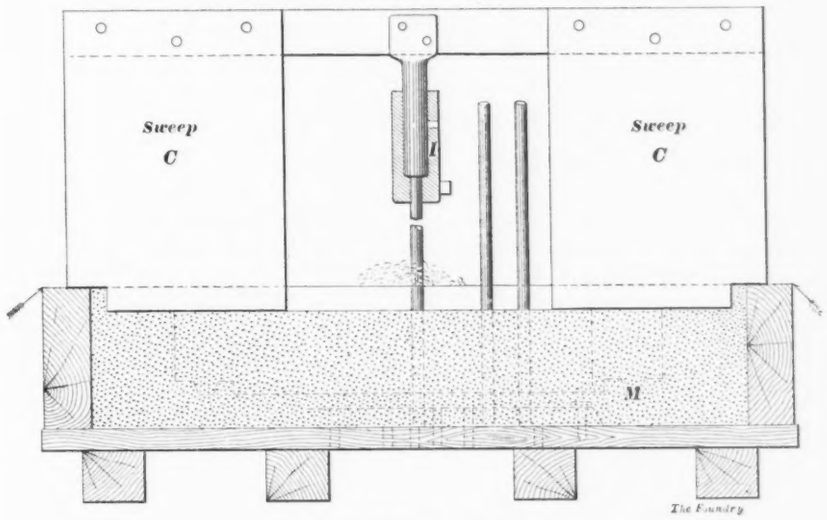


FIG. 8—SECTION OF DRAG

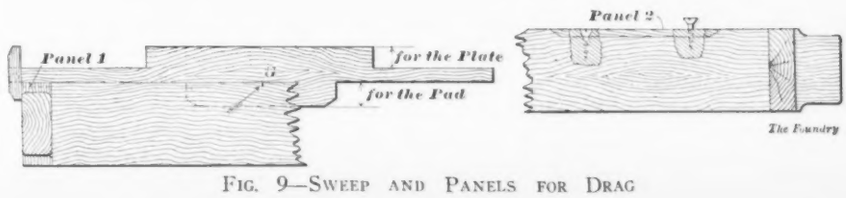


FIG. 9—SWEEP AND PANELS FOR DRAG

THE HEATED MIXER FOR THE FOUNDRY.

One of the radical differences between European and American cupola practice is the general use of the forehearth on the other side. The European founder prefers to set his tuyeres low down, leave a large opening for the flow of iron into the forehearth, which is partially heated by the blast from the cupola. The stream of metal therefore, once begun, does not cease until the wind is off, or the heat ended. The forehearth, which is practically a stationary bull-ladle, is tapped in place of the cupola itself. The result is a good mixture, as suf-

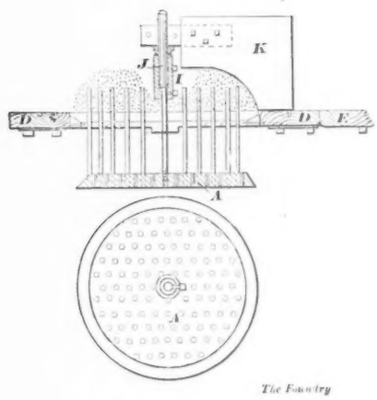


FIG. 10—ANCHOR PLATE

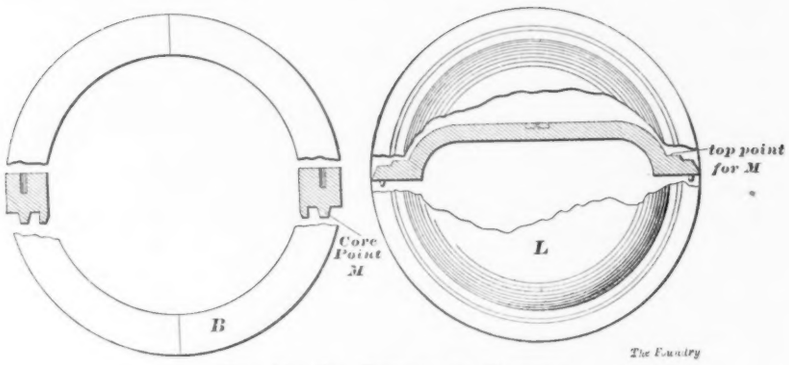


FIG. 11—TOP PORTION OF PATTERN

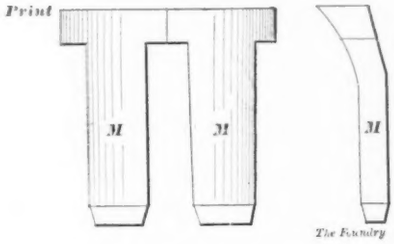


FIG. 12—DRY SAND CORES

ficient iron is always kept in the basin, but the metal must suffer slightly in regard to temperature.

The attention of our American foundrymen has of late been directed to the question of heated mixers for the foundry. The papers of J. B. Nau have given considerable information in this line, and being of a tilting type and heated very highly, these mixers are ideal for the foundries where the tonnage is large enough to warrant the expense.

The thought naturally comes to one as to how this excellent method could be made available for the smaller foundry, which has all the difficulties of the large foundry regarding lack of fluidity in the iron, and a few more besides. There is but one place where melting is done in the cupola, and that is in the melting zone above the tuyeres. Everywhere else it is colder, even in the bottom which is filled with incandescent coke. Where iron as free from sulphur as possible is demanded, as for instance light castings to be machined, it is customary to tap quite frequently, in fact almost let the stream run continuously, with the obvious disadvantage of improperly mixed iron. Were it possible to use a mixing basin, kept very hot, and which could be tilted without interfering with the cupola, it would fill a long felt want. So far trials have always been made with oil, with little encouragement for the iron foundry. A proper arrangement to heat the mixer independently, might help to solve the problem and less attention would be required in charging in the first place.

We therefore commend the idea to our inventors, who if they could devise an apparatus filling the above requirements would find a profitable field in American foundry practice.—RICHARD MOLDENKE, *Transactions of the American Foundrymen's Association.*

THE MANUFACTURE OF LARGE CASTINGS*

Relations of the Foundry Department and the Department of Engineering Design

BY W. A. BOLE

THESE NOTES have special reference to the design and manufacture of large and complicated castings; castings in which the material must be intrinsically strong and in which all of the various elements of a complicated casting must work harmoniously to accomplish the engineering purpose intended.

Small castings, as a rule, require much less consideration for two reasons. First—It is not usual to demand high strength in small iron castings because the designer will usually make a section thick enough to permit of pouring the metal—obtaining this information either from his own observation or by the foundryman's advice—and for most small objects the sections thus determined are more than ample for considerations of strength. Second—Thin castings, by virtue of their more rapid cooling, are almost certain to be stronger per unit section than would be the case if the same metal were poured into larger and heavier shapes.

Strength of Large Castings.

Many large iron castings are, I believe, of questionable strength and of doubtful reliability, even though they have not as yet broken in service, because of internal strains and lack of harmony between their constructive elements. This may be true even though the casting is poured out of iron of the best quality, and may be due to inconsistencies of design occasioned by lack of experience on the part of the designer, especially in the cooling and shrinking of the various parts of a large casting after being poured.

The physics of cooling, shrinking and synchronous contraction is a study which the foundryman should be better able to follow, and to become expert in, than the designer; and the engineering department of a manufacturing plant making large

*Presented at the annual meeting of the American Society of Mechanical Engineers.

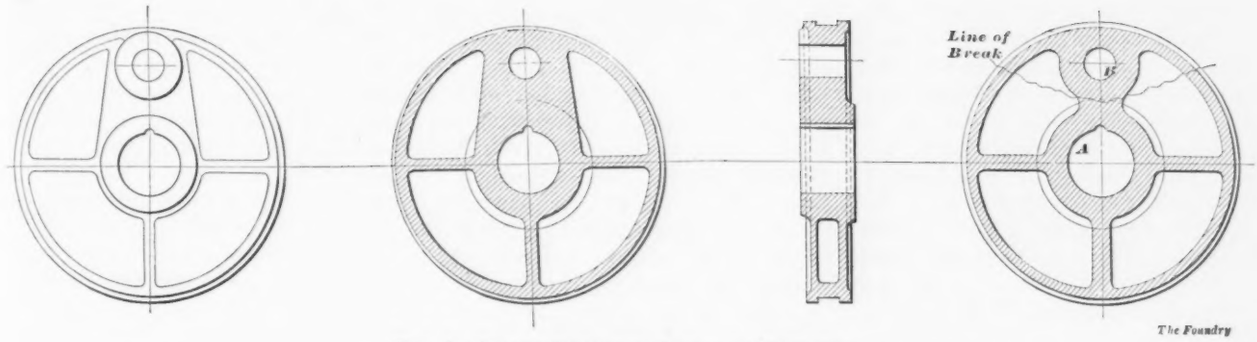


FIG. 1—CRANK SHOWING LINE OF FRACTURE

iron castings of complicated shapes, would do well to consult foundry conditions very carefully before finally determining upon and accepting designs for such castings.

The foundryman's knowledge of the physics of the foundry should qualify him to anticipate some things not generally known to the average draftsman, and often not known to the supervising engineer.

Drawing Room Assumptions.

The usual drawing room method is one of making assumptions in design by which sections of castings are regarded as beams of various sorts, loaded in various ways, as pillars, as sections in tension and sections in compression, etc. These assumptions are made as though the said members and said sections were of cold materials, put together in such a manner as to allow each section to remain normal to itself, as would be the case in building up a bridge truss, securing member to member by rivets or pins. Unfortunately for such assumptions the casting must go through the stages of molten, red hot and cold conditions before it is in its final form, and what happens during these changes of state may entirely upset the engineering assumptions upon which its members were calculated, and when the casting is cold, some members which were expected to be in tension may be in compression, and vice versa, others that had been intended for compression may be actually in tension. It is therefore necessary in designing to consider carefully whether the casting, after having passed through these formative stages will ultimately be as the designer assumes.

Design of Castings.

Castings are often designed with a useless multiplicity of ribs, walls, gussets, brackets, etc., which by their asynchronous cooling and their inharmonious shrinkage and contraction, may entirely defeat the intention of the designer. He may find some of his walls, ribs, or brackets cracked before the casting is cleaned. It is sometimes possible to remove such superfluous walls, ribs and brackets, and thereby obtain not only a lighter but a stronger and more dependable casting.

It is highly essential that the designer keep in mind, as nearly as he can imagine, the cooling processes through which the casting must pass, and the effect which will be produced upon any given wall or member of the casting if it is cooled faster or slower than the other parts of the same casting. It would be difficult to set down any considerable number of rules governing this matter, but it may be of advantage to call attention to the necessity for careful study of this and of related subjects.

Cooling.

The outer walls of a casting, that is to say those which are more nearly adjacent to the sides and radiating surfaces of the flask, are naturally the first parts of a casting to lose heat, to fall in temperature, to begin to contract and decrease all their linear dimensions. The inner walls of the same casting, being more isolated from the outer and conducting surfaces of the flask, may remain hot for a much longer period than the outer portions; as a consequence the outer members of certain castings may cool and take on their ultimate dimensions while the inner members are still very hot. The latter will, of course, ultimately cool off, but they will also continue to contract until at normal temperature, and their freedom of contraction may be prevented by the already determined dimensions of the outer walls; as a result there is likely to be violent tension strains in the interior walls of such castings. Sometimes these strains are sufficient to cause rupture while the casting is still in the mold; sometimes the casting does not rupture until it is out in service, and even if it breaks in service the rupture may not be produced by stresses of engineering design, but may be due to the original asynchronous cooling of the various parts of the casting.

There are some castings which, by virtue of their shapes, can be specially treated by the foundryman, and artificial cooling of certain critical parts may be effected in order to compel such parts to cool more rapidly than they would naturally do, and the strength of the casting may by such means be beneficially affected. As for instance in the case of a flywheel with heavy rim but comparatively light arms and hub; it may be beneficial to remove the flask and expose the rim to the air so as to hasten its natural rate of cooling, while the arms and hub are still kept muffled up in the sand of the mold and their cooling retarded as much as possible. Or in the case of a flywheel with an ordinary weight of rim and arm but with a heavy hub; the hub may be exposed and compelled to cool more readily than it naturally would, while the arms and rim are kept muffled in sand, and the synchronous cooling above referred to is at least approximated to a greater extent than if all parts were allowed to cool naturally.

Use of Fillets.

It is often thought that large fillets are fine features of design in work of this sort, but many times they are highly detrimental to good results. Where two walls meet and intersect, as in the shape of a T, if a large fillet is swept at the juncture, there will be a pool of liquid metal at this point which will remain liquid for a longer time than either wall because of its lessened facilities for quick cooling, and this pool of liquid metal is bound to act as a feeder, supplying metal for other parts, lower in

the mold, that may shrink sooner, the result being, in practically every case, a void, or "draw," at the juncture point, bad enough in any case, but made worse by the presence of the large fillet. Of course there may be trouble from such intersections where no fillets at all are used, but the fillets should be kept small with the idea of allowing both walls and juncture to remain as nearly uniform in thickness as possible, and to have as nearly as may be the same capability for simultaneous shrinkage and solidification.

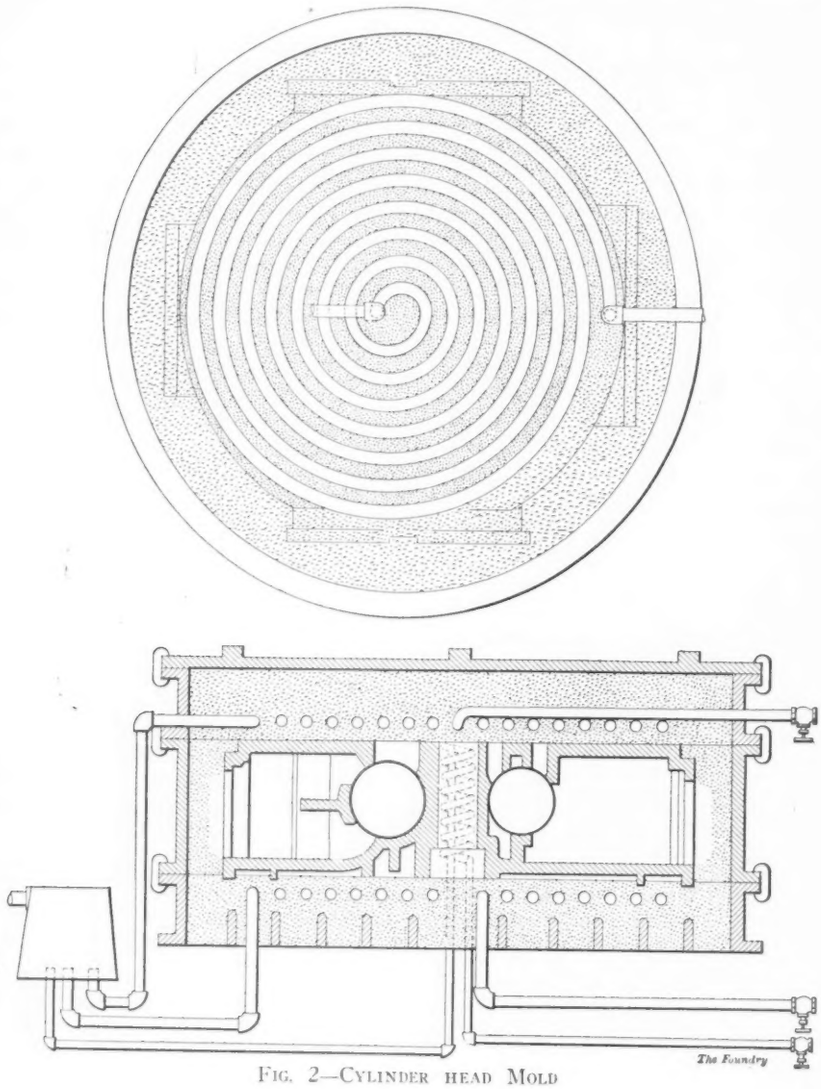


FIG. 2—CYLINDER HEAD MOLD

Jacketed Cylinders.

Among other classes of difficult castings I would place jacketed cylinders in the list of castings requiring careful consideration in design. In considering the case of a gas engine cylinder which is to be jacketed, the inner wall which resists the strain of explosion must be quite thick in order to afford the requisite strength against explosion pressures of ordinary nature and also against abnormal pressures due to pre-ignition and other causes. A cylinder of this sort, whose internal diameter might be 40 inches, could well have a thickness of cylinder wall amounting to three inches or more. The outer wall forming the jacket has only to stand the ordinary pressure of the cooling water, which might be quite low, often not exceeding 60 to 80 pounds per square inch, even where water is used direct from the city main, and an outer jacket wall 1 inch thick might, on ordinary engineering assumptions, be regarded as ample to care for this pressure.

If the cylinder wall and the jacket wall are continuous, that is to say, if each extends rigidly from one end of the cylinder to the other, there is likely to be trouble when such a cylinder is cast or cooled, and even if it does not break at the start it is quite likely to break in service later because of the fact that a wall of metal 1 inch thick located out near the sides of the flask which act as cooling media, will not shrink in time with the inner wall whose thickness is three times as great and whose opportunity for radiation is quite inferior. It is reasonable to expect that the outer wall will cool first; will take on its final dimensions while the inner wall is still very hot; at a later period the inner wall will shrink to normal temperature and will find that its desire to contract is restricted by the compressive strength of the outer jacket wall, and the effect is a high degree of tension in the working cylinder wall. In such a case one good feature of design is to interrupt the jacket wall so that the inner or working wall may have its own way and be unhampered in contracting; afterward it is closed up and rendered water tight by suitable mechanical means.

Design.

In such a case as that just cited, if the jacket wall must be cast continuous with the cylinder wall, it should not be designed solely in connection with its own theoretical stresses, but should be thickened up and made to approximate the working cylinder wall, so that it may cool down and contract more nearly simultaneously with the same, thus relieving the casting of stresses produced by asynchronous cooling. Such outer walls, and all such attachments to a large casting as bosses, pads, and the like, should be designed not alone out of consideration to the working strains which will be applied to such bosses or pads, but the tendency of the iron to chill at such spots must be considered, and frequently the pads or the bosses require to be made several times as large as mere reasons of strength would dictate, to avoid a hardening and whitening of the iron in thin sections that would prevent its being machined to required dimensions.

Cores.

After the foundryman has accepted the design and begun the work he may have several things to do in order to produce a reliable casting. If it is a cored casting he must guard against the cores being so strong that when confined within the contracting casting they will produce rupture of the metal. Among the usual means employed for producing a collapsible condition of core may be mentioned the use of sawdust or coke or ashes, or a combination of them all, some of

which ingredients will burn out as the casting cools and provide thereby for a collapse of the core. In other cases removable pieces, collapsible core arbors, straw-wrapped core arbors and the like, tend to prevent castings from cracking because of an unyielding core.

Use of Risers and Sink Heads.

In order to serve engineering purposes, castings should be not only apparently sound but really so. For this purpose risers and sink heads should often be employed on iron castings where they are not at present used. Steel foundry conditions compel such precautions to insure soundness, but in large iron foundry work interior cavities may exist without detection, and some of these may be avoided by the use of suitable feeding devices, risers and sink heads. If risers are not employed, the upper or cope side of the casting is likely not to be solid, because of the metal in the upper portions flowing or bleeding away from the interior of these sections to feed the shrinkage and the contraction in the lower portions of the casting. Gravitation is at work here as elsewhere, and as the sections of the casting that are lowest cool and pass from the liquid to the solid state, the diminished volume of the solidified iron produces demands for fresh liquid metal from above to fill the voids, so that the upper portion of the casting is in such cases sacrificed for the benefit of the lower part. The top surface of such a casting may apparently be solid, but if drilled deeply, as for stud bolts or other purposes, it is likely that cavities and extreme openness of grain will be disclosed. In some such cases good can be accomplished by the use of local chills placed under the top flange, if a cylinder for instance, which chills will set the metal in the flange before it has time to feed out of this region into any lower portion of the casting.

If specifications do not call for sink heads or risers, they may not be applied in the foundry, if the foundry has no interest in the design, and the resulting casting may be quite otherwise than as the engineering department had anticipated. The making and the cutting off of the sink head costs the foundryman heavily, and he may not be willing to spend the extra cost involved in the sink head method, and he may really not know whether the requirements are severe or otherwise.

Strength of Castings.

In some large castings intrinsic strength per unit section may not be a serious requirement. The amount of metal provided for reasons of mass, or for other reasons, being so ample that the working strains per unit section are low and are easily complied with. In other cases the engineering design may require high quality of material because high working strains per unit section are to be imposed upon the finished casting. In such cases engineering attention should be paid to the size of the test specimen which is to furnish an index of quality, and to the relation which exists between the strength of cast iron when cast into light test pieces and that of the same metal when cast into heavy sections.

The writer has taken specimens from an iron casting having at one point in the casting tensile strength as high as 30,250 pounds per square inch, and as low as 20,502 per square inch in another and heavier section. The difference in this was wholly related to the thickness of the section and to the rate or speed of cooling, with its consequent effect upon the grain, and upon the strength of the iron of which the casting was composed. It might be said that large sections cannot be cast to yield the high strength that is sometimes associated in engineering minds with specimen test pieces cast in smaller sections of prevailing sizes.

It is well that the foundryman be acquainted to some extent with the engineering purposes for which these castings are intended. This knowledge will enable him to pay particular attention to such points or parts of the casting as are specially critical and to such as are to be machine finished. He can usually arrange to place his chaplets, anchors and core vents so as to keep them clear of the working or sliding machined surfaces, and he can then better provide for producing a casting which is a clean one at these critical points. The molder, if left to himself, may and probably will, put chaplets and anchors directly in the path of a machined slide, unless someone who knows better sees him and prevents it. Sometimes this kind of information would seem to be obvious, but often it is not so, and a hollow cylindrical casting with flanges on each end, might, for all the molder knows, be a pipe having no special requirements, whereas it was intended to be a cylinder, which must be bored, faced and generally machined, and must be perfectly free from defects, and a casting in which chaplets and anchors are utterly inadmissible.

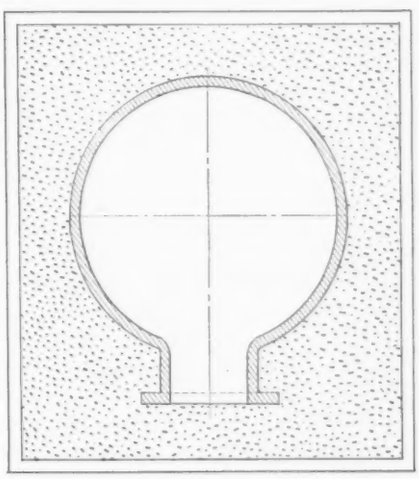


FIG. 3—IMPROPER DESIGN OF FLANGE

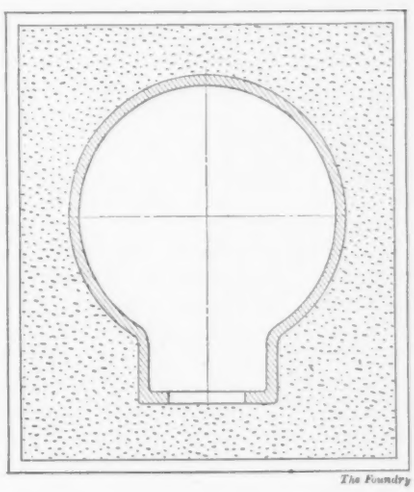


FIG. 4—FLANGE PROPERLY DESIGNED

Use of Chills.

Certain points or spots on a large casting may require to be drilled and tapped and may demand a high quality at that spot. A suitably located chill will insure soundness and solidity here if the foundryman knows what is demanded; if he does not know, the casting is made, looks good to him, is shipped out, and when machined is found to be hollow, cavitated or spongy at the critical spot.

In ordinary cases, designs for castings should be such that it will not be necessary for the foundryman to pay particular and extraordinary attention to special or heat treatment, because in the press of other matters, such treatment may occasionally be forgotten and omitted, or it may be imperfectly done by inexperienced men. A casting is best designed if it

can be uncovered promptly after pouring, lifted out of its bed and deposited on the floor of the chipping shop. This is what is done with 95 per cent of the output of the average foundry, and it is what the workmen are accustomed to. Special cases soon become irksome and some one will perhaps assume the responsibility of saying: "This special treatment is all foolishness and the casting is just as good without it." There are, however, cases in which it is necessary to design castings that do demand this special treatment.

Crank Disc.

A peculiar crank disc which was made in an iron foundry under the author's management some five or six years ago is shown in Fig. 1.

The first casting was poured in the usual and ordinary manner, and after a decent delay in the flask was uncovered and removed to the chipping shop. It lay on the floor of the latter department for a day or two after cleaning; it was then shipped to the machine shop, which is located about twelve miles away. When the casting arrived at the machine shop it was found that it had been so stressed by internal strains that a large piece had not only broken away from the balance of the casting, but it had jumped clear off the railway car on which it was being conveyed, and the missing piece was found by a track walker alongside of the railway track a few hours after its loss was reported. The line of breakage is indicated on the sketch, and the missing piece weighed perhaps 1½ to 2 tons. This case was studied carefully; the heavier interior member, being the last of the casting to cool, had set up the violent internal strains which caused the casting to rupture.

We arranged the next casting so that a few minutes after pouring, a small stream of water in a regulated quantity was caused to drop into the hollow cores A and B, compelling the hubs surrounding these cores to cool in advance of their natural time, and at least approximate synchronous cooling with the balance of the casting. The other portions of the casting during this period were kept muffled up in the sand and their cooling was delayed, while the cooling of the crank hubs was accelerated. After this method was adopted 12 such castings were made, all good, and they have been in service for some years.

Cooling Treatment For Special Cases.

The writer had to produce a number of large cylinder heads for Corliss engines, these heads having ports for steam and exhaust valves formed in the heads. Structurally considered, these heads were like a cylindrical steam drum of large diameter but of very short length, having a flat head at each end, and were required to stand internal pressure.

Considering the resistance to internal pressure, the cylindrical shell or outer wall could be designed quite thin as the strains in it were all tensile strains, while the heads, being flat and of great area, were subject to bending strains which demanded that these be greatly thickened up to make the flat surfaces, not easily stayed or braced together, strong enough to carry safely the pressure. In addition to this greater thickness of flat head, allowance had to be made for a machine finish on the flat surface, which was not required by the shell, and the disparity thus became still greater. The port openings for the admission and exhaust of steam, made large holes in this head or flat plate, which were to be tied across ports by bars or ribs. In cooling by natural processes these bars almost invariably cracked in the casting, because the cylindrical shell being thin, cooled first, and was assisted in doing so by its position, which was very close to the sides of the flask, where radiation was active. The flat head, on the contrary, was at the bottom of the flask, where radiation was poorer, and it was practically twice as thick as the rim, and cooled more than twice as slowly. With these divergent tendencies in the casting trouble ensued. The rim cooled early and took on its final dimensions and in the form of a circle opposed to compression—the strongest possible shape. The head, or plate, or diaphragm, cooling later, had its contraction tendency resisted by the stiff rim and a struggle was set up. The tension member was of course the weaker and the large openings in the latter made the result a foregone conclusion—the diaphragm simply had to shrink or be stretched, the rim would not give—the ribs broke.

How the Difficulty Was Overcome.

We cured this trouble by the following means: In the drag portion of the mold we placed a spiral coil of iron pipe, Fig. 2, through which we could circulate cooling water. This coil was placed as close to the face of the pattern as was considered safe, about 1½ inches away. The inner cores by which the head was hollowed out were also provided with similar interior cooling coils and the cope had a coil like that of the drag. After the casting was poured we waited for a few minutes to enable solidification to begin, and then we turned water into these cooling coils, and connecting the overflow to sewer connection, let the water run all night. The casting lay in the mold, the rim kept muffled in sand to delay cooling, while the coils close to the heads accelerated cooling. The result was most satisfactory and the castings produced by this process have stood the severest tests of several years continuous duty without failure.

Shapes.

It might seem almost unnecessary to say that shapes of sections, flanges and other projections, should be so designed that the molder may most easily produce the desired shape without having to use complicated means. If the designer or draftsman were a man who had a little practical experience in foundry work he would see numerous opportunities for making shapes that would "draw" easily, rather than certain other shapes that look well on paper but are much harder to produce. Of course the foundryman can produce almost any conceivable shape if he has to, but engineering design is at its best when its shapes are at once suitable for the intended purpose and easily and cheaply produced. On work of considerable size a little more time required to deal with a detail may prevent doing any pouring today, with a strong probability that the molder can make that job last him "until tomorrow night." The designer should try to put himself in the molder's place and imagine himself making the mold in question. Then he will see what a small difference in design sometimes causes a big difference in cost and risk. An instance of this is Fig. 3 and represents a prospective nozzle with a flange for steam or water connection.

If the flange in Fig. 3 is at the bottom of a complicated casting it will require the flange pattern to be cut into removable sections or a troublesome embedded core is required. If practicable to design as in Fig. 4, the neck draws naturally and the main core forms the flange. This sort of change may not always be possible, as certain designs will demand loose bolts, while Fig. 4 would call for stud bolts, but there are cases in which the foundry's troubles can be reduced in this manner.

DESIGN OF THE IRON FOUNDRY

Its Location and Arrangement of Various Departments—Model Layout

BY OSCAR E. PERRIGO

IN manufacturing operations the importance of the iron foundry can hardly be overestimated. This department must produce good castings at a minimum cost. While it is true that designs must be formulated and drawings produced in the drafting department, and patterns made in the pattern shop, yet the beginning of the actual manufacturing operations on a large number of machine parts, particularly of the heavier and more bulky kind, will be in the iron foundry.

Location of the Foundry.

In locating the iron foundry with reference to the other buildings composing the plant, several distinct requirements demand consideration. In a general way it should be near its own base of supplies. It should be in convenient reach of the other departments with which it is most intimately connected, and yet not in such a position as to render the peculiar nature and condition of its work disagreeable or detrimental to the efficiency of other departments. These conditions may be summed up as follows:

First—In bulk, the foundry usually consumes a greater quantity of raw material and supplies than all the other departments of the plant. Hence, one of the first considerations will be to place it where it may be readily reached by a railroad siding if located inland, or near a wharf if located close to navigable water, in order that it may conveniently and economically receive its supplies of coal, coke, sand, pig iron, scrap, etc.

Second—In view of the fact that the routine work of the foundry is to a considerable extent connected with the drafting room or engineering department, and still more intimately with the pattern shop, it should be so located as to be within convenient reach of these departments, with proper facilities for moving patterns back and forth as necessary.

Third—The location of the foundry with reference to the pattern storage, or vice versa, must be considered and facilities should be provided for quickly moving patterns that there will be no reasonable excuse for leaving them lying around the foundry after they have been used.

Fourth—The foundry should be located that the castings may be passed directly into the cleaning room, and from that point by a short, direct route to the machine shop.

Fifth—Owing to the smoke, cinders and dust generated in the foundry, it should not be located so close to the machine shop or power house as to be a source of annoyance to the employes in these departments, or cause damage to the machinery.

Other Requirements.

There are other considerations and requirements necessary in locating a foundry which are self evident but to which attention might be incidentally directed.

The nature of the ground is important. If near swampy land or a body of water the floor level should be raised sufficiently above high water mark to preclude the possibility of moisture affecting the molding pits, if this class of molding is to be done. It is practicable, of course, to have these pits and also the entire foundry floor, cemented to exclude water, and this precaution should always be taken, at least as far as the pits are concerned.

Plant in a Confined Area.

The plan view, Fig. 1, shows the arrangement of the buildings of a plant in a confined space. It is a model arrangement in some respects, but its practical usefulness would doubtless be improved if the foundry were not in such close contact with the machine shop, being separated from it only by the thickness of a brick wall. The same objection can be advanced regarding the location of the tool room and engine room, while the pattern shop and pattern storage are a considerable distance away from the foundry. This plan could be improved by locating the foundry further to the left. It is 150 feet long and might be moved 100 feet, and in the space thus gained between it and the machine shop, a cleaning room 50 x 100 feet might be erected. This would not be objectionable as the adjoining walls of the machine shop contain no windows and the annoyance of dust would be eliminated. Thus the changed position of the foundry would provide a larger yard, and the walls of the cleaning room would be over 60 feet from the tool room. There would still be 150 feet of available space at the rear of the foundry for its extension when necessary, whereby its capacity might be doubled. In addition, the foundry would be 150 feet nearer the pattern shop and the pattern storage room.

Compact Arrangement.

A compact arrangement of the buildings of a plant with the foundry located advantageously in many respects is shown in Fig. 2. The machine shop occupies one entire side of the plant. A railroad siding runs the entire length of the plant on the opposite side and is utilized for bringing in all kinds of raw materials and supplies, as well as for shipping the product. The offices, show, store, and shipping rooms are on the first floor. On the second floor of an extension is the pattern shop over the show room, the pattern storage over the shipping room, while the drafting room is above the offices. If a large number of patterns are to be stored, a third floor might be added to the extension. In this case the office building should be of three stories high that it will not be dwarfed by a subordinate structure. The forge shop and cutting-off room are located next to the shipping room, separated from it by a driveway, and the remainder of this side is occupied by storage sheds. Should additional storage space be required for patterns, and it is not deemed advisable to add a

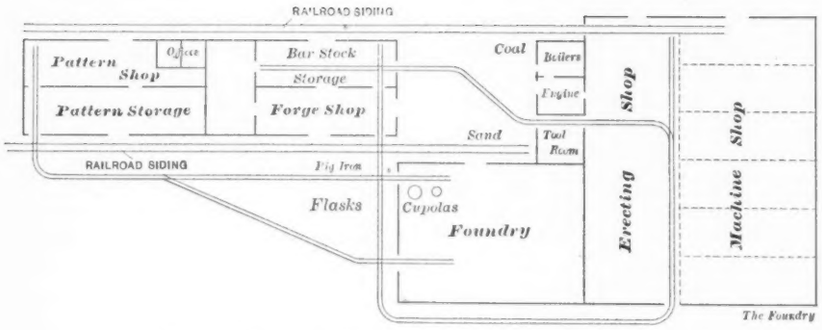


FIG. 1—PLANT ARRANGED IN VERY LIMITED SPACE

third floor to the pattern shop or the extension, these storage sheds might be built wide enough to cover the yard track and a second story added for pattern storage.

The foundry is located at the rear end of the plant, with the cupolas on the side next to the storage shed for convenience in handling raw material, and the flask room and cleaning room on the opposite side, but far enough removed from the machine shop so as not to be objectionable in any way. Only the general shop and yard tracks are shown, to give an idea of their connection between the several parts of the plant.

This arrangement furnishes a large internal yard, keeping everything within the rectangle comprising the plant. It is convenient to close up at night and can be easily controlled by the watchmen. Extensions can be readily made toward the rear of the plant, increasing the capacity of the foundry and the machine shop to any extent; or, if it is desired to increase the foundry capacity without going beyond the limits of the rectangle, the extension can be made toward the front.

Another Layout.

The plan of a plant given in Fig. 3 is an improvement over those shown in Figs. 1 and 2. In this case the foundry is placed at the front of the plant so as to be convenient to the pattern shop and pattern storage building. This building connects the foundry with the machine shop building and has the flask room and the tool room for the machine shop on the first floor, being divided by a gateway giving access to the front of the plant. On the second floor of this building is the pattern shop and on the third the pattern storage, an elevator connecting the different floors. The foundry, pattern shop and machine shop buildings are separated by fire walls extending above the roof, having the necessary openings protected by automatically closing fire doors.

This layout has the advantage of a railroad siding extending the entire length of the plant, and from it a second track passing across the rear and through the store house and machine shop. The principal lines of shop and yard tracks are shown to give a general idea of their arrangement and the facilities afforded for receiving raw material and supplies and their distribution to the various departments. These tracks also afford ample inter-departmental transportation and facilities for shipping the product.

This plant may be enlarged by extending the foundry to the rear, even to twice its present length, and erecting another machine shop building alongside the present structure equal to it in size, thus bringing the square structure for offices in the center of the front of the enlarged machine shop buildings. In a similar manner the power house may be extended further into the yard or widened, and the forge shop, store house and pattern building widened to twice the present capacity. These changes will be simply a development of the plan and will not disturb its general symmetry.

The object in showing this plant arrangement is to illustrate the relative position of the foundry to the other component parts of the establishment and to show the transportation facilities between them.

Plan of Foundry.

In Fig. 4 is given the plan of the foundry building on an enlarged scale, showing in more detail the arrangement of its different departments or divisions and its transportation system. The main building is 100 x 250 feet, and has attached to it an extension 60 x 60 feet for the cleaning room. The building is of brick construction and consists of a central bay 50 feet wide, with side bays 25 feet wide. At the front the pattern building joins it, giving a room on the ground floor for making, repairing and handling flasks, which is also 60 x 60 feet. From this room an elevator runs up through the pattern shop and onto the pattern storage or third floor. Minor repairs on patterns may be made in the flask room or by one of the workmen, when needed, on the foundry floor. An office on this side of the foundry accommodates the foreman, and from its location permits him to see all parts of the foundry. On the opposite side, and at the center of the length of the building are placed the cupolas with their charging platforms extending on three sides, enclosed at either end by a substantial brick wall. On the ground floor is a small office for the clerk in charge of incoming supplies, such as pig and scrap iron, coal, coke, etc., and also of the finished product. The yard track passes close to the building, and at this point is protected by a light structure under which is the track scale upon which cars of material are weighed. They then pass over the turntable and upon the elevator which raises them to the charging platform, which is also provided

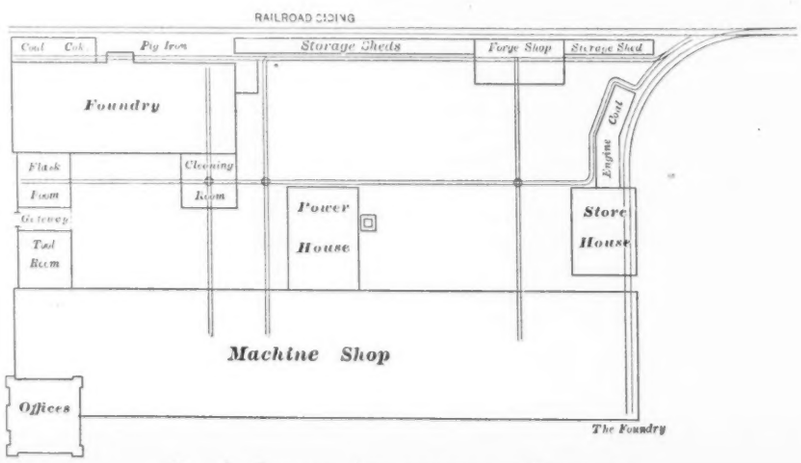


FIG. 2—COMPACT ARRANGEMENT OF BUILDINGS

with tracks to each cupola. This platform gives ample space for handling two or even three full charges for each cupola, so that a constant reserve supply may be on hand in case of emergencies. The space beneath the cupola platform is ample for the accommodation of motors and blowers, while the space at the right is reserved for the air compressor, its tank and the motor which operates it. Compressed air may be brought from a central compressing outfit located in the machine shop building or power house, but there are several advantages in providing separate plants for buildings at some distance from each other. For convenience, these two spaces may be used in common by making a suitable opening in the cupola platform wall which separates them.

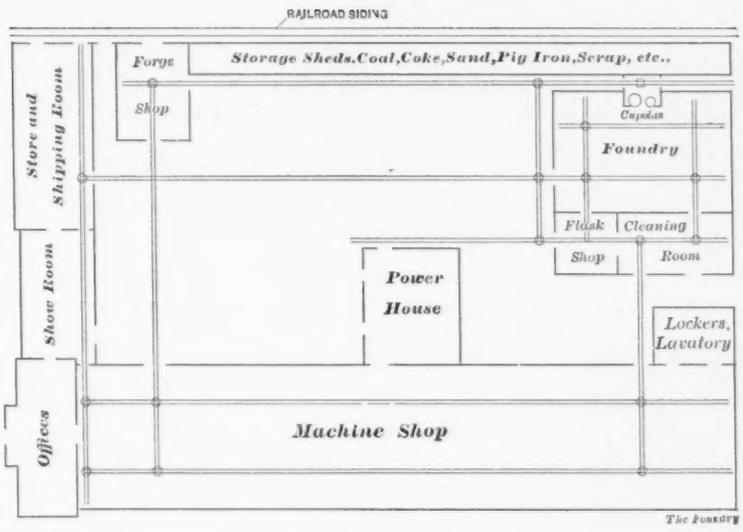


FIG. 3—THE FOUNDRY, FIG. 4, IS ONE OF THE DEPARTMENTS OF THIS PLANT

At the right of the cupola platform is a gallery floor reached by a flight of stairs at each end. This floor accommodates a store room for small tools and supplies, a locker room for the workmen, a lavatory and the water closets. With this arrangement considerable ground floor space is saved. At the left of the cupolas are located the core ovens, the first admitting cars 16 feet long, and the second cars 12 feet long, each having a capacity of four cars. These cars should be built with ends that completely fill the door space, so that whether the car is run in or drawn out the opening will be completely closed and the heat of the oven retained without the use of sliding or swinging doors for that purpose. It will be readily seen that both the length of the cars and their number will be governed by the nature and size of the castings. These conditions will also determine the amount of space devoted to making cores. In this case the space allotted is 24 x 40 feet. For some classes of work this allotment should be doubled. Economy of space in the actual making and baking of the cores is obtained by placing a gallery floor over the core department and erecting suitable racks for the storage of cores. Stock cores which may be made up at any convenient time can be kept here for use when required. The heat rising from the core ovens will facilitate the seasoning of cores and will shorten the time required for baking them. This floor is reached by the stairs shown near the core ovens.

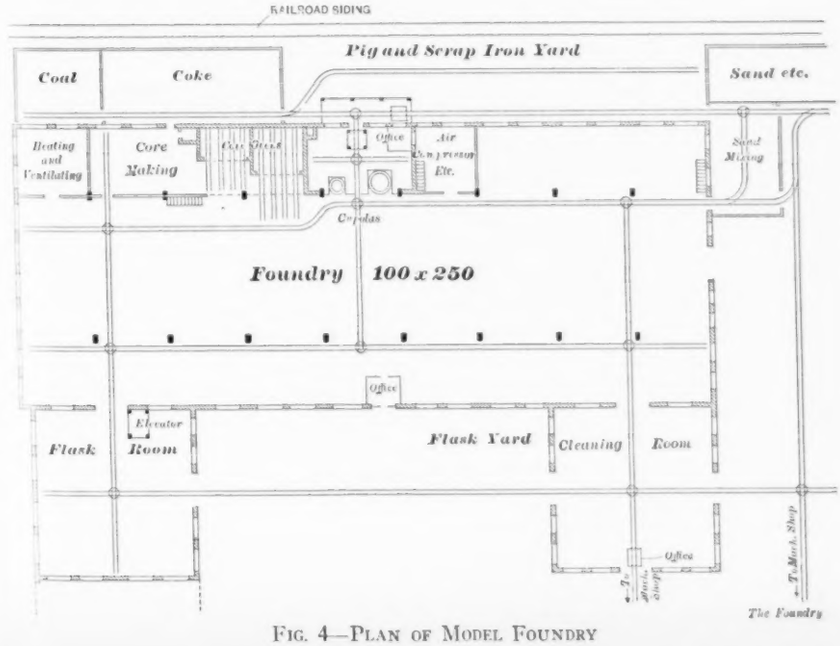


FIG. 4—PLAN OF MODEL FOUNDRY

At the left of the coremaking room and extending to the front wall is a room for the heating and ventilating apparatus, assuming that this is accomplished by the warm draft system which will be found well adapted for this purpose.

Between the outer wall of the foundry and the railroad track and beginning at the front line is a storage shed 26 x 96 feet for coal and coke. This is conveniently reached by cars on the yard track running the entire length of the foundry and immediately outside of it. The remainder of the space between the foundry and the railroad track is used as a storage yard for pig and scrap iron, and a branch from the yard track above mentioned runs through its center. At the right of this space is a long storage shed whose size is better shown in the general plan, Fig. 3, and which is used for the storage of sand of various grades, fire sand, core sand, fire clay, etc. In the angle formed by the rear foundry wall and the long storage shed is a sand mixing shed where the usual mixtures of sand are made and by means of the yard cars are delivered to the foundry ready for use. The shop and yard tracks, with the necessary switches and turntables are also shown.

PHILADELPHIA ASSOCIATED FOUNDRY FOREMEN.

At the monthly meeting of the Associated Foundry Foremen of Philadelphia and vicinity, held on Monday evening, Dec. 9, it was unanimously decided to increase the annual dues for active members from $2 to $4. This was done to provide funds to carry on the work of this organization more efficiently.

CHARCOAL IRON FOR THE FOUNDRY

A Discussion of Chemical and Physical Properties—Analyses of Various Grades

BY HARRY B. DePONT

WITH charcoal as fuel for the blast furnaces and good grades of Lake Superior ores, a greater variety of iron suitable for foundry use can be produced than by the use of coke. Charcoal pig iron is made in many grades, and there is a heavy demand for the clear white iron, or "hard six," to the first grade coarse grained soft iron. The silicon content ranges from 0.03 per cent to 3.50 per cent, and iron containing only a trace of silicon has been shipped, although it is the general practice among furnace operators to charge this back into the stack. As shown in Table I, No. 6 iron has a variation of 11 points and ranges from 0.03 per cent to 0.14 per cent.

Table I.

No. 6 Charcoal Iron.

	Si	S	P	Mn
1	0.03	0.026	Variable according	—
2	0.06	0.026	to ore content.	—
3	0.09	0.025	From 0.160 to	—
4	0.11	0.025	0.250 per cent.	—
5	0.14	0.024		

Although exceedingly low in silicon this grade of iron is regularly used by chilled plow and car wheel makers. A buyer of our iron received a carload of No. 6, containing 0.04 per cent silicon. He stated that there must be some mistake as he believed it was impossible to make pig iron running so low in silicon. We informed him that the silicon was right, and that such iron is a regular and common product in charcoal practice. The grain of this particular grade of iron is very close and presents a clean white fracture. It is almost useless to attempt to drill it and a file would soon be stripped. A coke iron of this sort would carry sulphur to the extent of 0.250 per cent or possibly more, and would be utterly useless, being honey-combed, brittle and fit only to go back through the furnace.

This iron may be made by reducing the heat of the furnace by increasing the burden and maintaining the temperature of the stoves between 850 and 900 degrees Fahr. in fact, one foreman uses this method and relies entirely upon the cooling effect of the increased burden in the bosh and upper melting zone. It is impossible to use this iron alone as it must be properly mixed, the object being to give the required chill to the casting.

The next iron is No. 5. Its silicon content ranges from 0.14 per cent to 0.30 per cent, as shown by Table II.

Table II.

No. 5 Charcoal Iron.

	Si	S	P	Mn
1	0.16	0.024		—
2	0.18	0.024	From	—
3	0.20	0.023	0.160	—
			to	
4	0.22	0.023	0.250	0.10
5	0.25	0.022		0.12
6	0.30	0.021		0.16

The higher the silicon the lower the sulphur is a good rule to follow, but there are instances where the sulphur will deviate a little from the general rule and run sometimes higher and sometimes lower, as shown below:

Table III.

No. 5 Charcoal Iron.

	Si	S	P	Mn	
1	0.30	0.026	0.177	0.20	higher
2	0.30	0.020	0.203	0.17	lower
3	0.23	0.017	0.257	0.12	low S low Si

There are reasons for this and it might be well to mention them. In the case of No. 1, Table III, we have silicon 0.30 per cent, and sulphur 0.026 per cent. Evidently the burden of the furnace for this cast was too lean, or in other words, lacked lime, and so the bath of iron, having a greater affinity for sulphur at a low temperature than lime, the excess of sulphur is accounted for. The sulphur contents of Nos. 2 and 3 are low, as compared with the silicon, which may be explained in two ways. First, the charge of lime was large enough to partly overcome the affinity of the iron for sulphur; second, the theoretical sulphur in the mix may have been very small, thereby allowing a small percentage of sulphur to be taken up by the iron. It does not take place, but a lime set could exert its influence to a marked degree on the sulphur at temperatures low enough to produce nearly a white iron, but such was the result and changes of a similar character are common in charcoal working. The increased burden for low silicon iron might sometimes be cared for by an excess of lime, but care must be taken that an increase in silicon does not occur, or a lime set, which is very bad for any furnace.

Manganese is an element in the iron which might be said to go hand in hand with silicon, for the higher the heat, the more of the oxide is reduced, and vice versa. In the higher silicons of the No. 5 group, manganese begins to show in small quantities and from this point on more of the oxide is reduced and more is found in the iron. There seems to be a rule, at least the writer has often heard it repeated, that manganese should be half the silicon content and should only vary a few points either way. This rule may be all right sometimes, but is not generally borne out by the facts as the ratio of manganese to silicon in different irons varies to a large extent. The manganese is reduced from the oxide in quantities proportionate to the temperature of the furnace and the theoretical oxide of manganese in the total burden, and therefore makes the half-and-half rule look foolish. If an iron contains 2.50 per cent silicon there is no reason to expect the manganese content to be 1.25 per cent, unless it is known that a high manganese burden is being used, and then the manganese might even go as high as 1.50 or 1.65 per cent. The manganese for the above 2.50 per cent silicon iron would probably be 0.89 or 0.95 per cent and never will it go in excess of the theoretical manganese in the total burden. The examples in Table IV are typical of the reduction of manganese.

Table IV.

CHARCOAL IRON SHOWING VARIATIONS IN MANGANESE.

	A		B		C	
	Si	Mn	Si	Mn	Si	Mn
1	0.55	0.26	0.64	0.22	0.89	0.74
2	0.46	0.23	1.83	0.68	0.72	0.68
3	0.50	0.24	2.66	0.65	0.51	0.53
4	0.61	0.30	1.68	0.65	1.58	1.07
5	0.30	0.15	2.51	0.82	1.25	1.01
6	1.48	0.70	1.86	0.70	0.60	0.61

A—Manganese half or about half.
B—Manganese less than half.
C—Manganese more than half, equal to and greater than the percentage of silica.

No. 4 iron ranges between 0.30 and 0.40 per cent silicon and is sold to car wheel, malleable and railroad foundries for various work requiring a certain degree of chilling qualities.

In Table V of No. 4 iron the sulphurs vary but not in accordance with the silicons, there being an increase in sulphur for a decrease in silicon and a decrease in one and the same in the other, showing, as previously stated, the different effects of the burden and temperatures.

Table V.

	No. 4 CHARCOAL IRON.			
	Si	S	P	Mn
1	0.30	0.019	0.196	0.15
2	0.31	0.021	0.244	0.38
3	0.33	0.022	0.234	0.14
4	0.35	0.022	0.230	0.19
5	0.37	0.019	0.198	0.20
6	0.40	0.022	0.260	0.15
7	0.43	0.022	0.249	0.24
8	0.25	0.015	0.200	0.20

No. 7, according to the grading at this plant, is a hard 3, but has been shipped for No. 4, while No. 8, a soft 5, has been sent out as a 4. Such deviations from the general limits occur not infrequently.

No. 3 iron has a greater range than any other and has for its limits 0.40 and 0.70 per cent silicon. This grade is also used for malleable and car wheel work. Iron has been shipped as No. 3 which contained as high as 0.85 per cent silicon, and a number of tons containing 0.77, 0.78 and 0.79 per cent silicon have been shipped as No. 3. Of course the same sulphur and manganese variations occur in the high silicon irons as in the low, but the high irons, as a rule, hold their sulphurs more uniform.

Table VI.

	No. 3 CHARCOAL IRON.			
	Si	S	P	Mn
1	0.40	0.018	0.253	0.17
2	0.42	0.020	0.230	0.18
3	0.44	0.020	0.226	0.21
4	0.46	0.020	0.232	0.22
5	0.48	0.021	0.179	0.26
6	0.51	0.021	0.205	0.21
7	0.56	0.016	0.230	0.30
8	0.58	0.017	0.207	0.30
9	0.61	0.020	0.185	0.38
10	0.65	0.019	0.197	0.33
11	0.67	0.014	0.183	0.44
12	0.70	0.019	0.210	0.34

Next to the greatest number of points of variation allowed a grade is No. 2, which has a range of 50 points from 0.70 to 1.20 silicon.

Table VII.

	No. 2 CHARCOAL IRON.			
	Si	S	P	Mn
1	0.72	0.019	0.240	0.46
2	0.74	0.020	0.235	0.49
3	0.79	0.020	0.241	0.59
4	0.82	0.018	0.227	0.40
5	0.86	0.019	0.234	0.44
6	0.90	0.019	0.186	0.46
7	0.93	0.018	0.209	0.47
8	0.96	0.016	0.206	0.46
9	1.00	0.017	0.207	0.51
10	1.05	0.018	0.179	0.56
11	1.10	0.016	0.198	0.54
12	1.14	0.017	0.215	0.70
13	1.16	0.017	0.219	0.40
14	1.20	0.016	0.203	0.75

Iron is frequently shipped according to fracture regardless of the silicon content, which accounts for the fact that iron running as high as 1.33 per cent silicon has been sent to consumers for No. 2. A coarse grained fracture, which, as a rule, denotes a high silicon, has after analysis shown a low silicon iron, and a fine fracture has very often shown a high silicon content. It is the writer's belief that fracture does not always hold and that chemical analysis is the only safe guide to consistent grading.

The last grade to take up is No. 1, and it does not seem necessary to go into details regarding its qualities. A few analyses are shown in Table VIII.

Table VIII.

	No. 1 CHARCOAL IRON.			
	Si	S	P	Mn
1	1.40	0.012	0.181	0.70
2	1.54	0.014	0.193	0.75
3	1.63	0.013	0.209	0.80
4	1.91	0.011	0.215	0.87
5	2.09	0.019	0.180	0.78
6	2.12	0.011	0.200	0.68
7	2.29	0.021	0.195	0.62
8	2.52	0.019	0.197	0.70

In Nos. 6, 7 and 8, Table VIII, we have a high silicon and comparatively low manganese, due to a low manganese mix, giving a low reduction with temperatures high enough to produce the high silicons. The sulphur in 5, 7 and 8 was caused by the use of coke with the charcoal.

The particular method of grading used at this plant may or may not be found at other furnaces, but the plan is generally the same and the ultimate effects are analogous. The many different grades of ore used have a marked influence on the fractures in charcoal iron for the reason that the iron must get all its silicon from the ore, as the fuel only contains a trace and the stone used here very little.

To obtain a high silicon iron from a low silicon mix necessitates high temperatures, extra fuel and not too lean a furnace, then the iron produced will very likely have a coarse grained fracture with a silicon content very much lower than would be expected from the grain. Again, if a high silicon mixture is used in the furnace, and a low silicon iron is wanted, the chances are more than ever that the fracture will be fine and compact, while the analysis will show high silicon. Of course, a grader can come very close to the silicon in the iron by becoming familiar with the general furnace operations and what ought to be expected from a certain mixture with the temperatures to correspond. He can accustom himself to the different fractures and by practice can judge within 10 points of the actual silicon, but there are also times when he might load an iron for a No. 3 by fracture which the analysis showed to be a soft No. 2. The iron from this furnace does not run high in phosphorus, and so might not be desirable for many classes of work where a high percentage of this iron is desired in the cupola charge.

MACHINERY BRASS.

By C. VICKERS

Question:—Kindly give us a good mixture for machinery brass, something which has good wearing and machining qualities. The castings are to be used for steam shovel work and must be produced for $0.19 per pound. In addition the company must secure its profit from this price.

Answer:—The following alloy will probably suit your purposes: Copper, 72 pounds; lead, 14 pounds; zinc, 10 pounds; tin 4 pounds. My note book gives the following characteristics of this alloy: Fracture, grayish; grain, dense; color, reddish yellow. It cuts well, is strong and a trifle hard. It can be used to good advantage for making cheap machinery castings.

SHEFFIELD BRANCH ORGANIZED.

A Sheffield and district branch of the British Foundrymen's Association was recently organized at Sheffield, Eng. Herbert Pilkington, president of the British Association, was temporary chairman and Prof. McWilliam delivered a very interesting address. Officers were elected as follows: Herbert Pilkington, president; vice presidents, Prof. McWilliam and Percy Longmuir; secretary, G. M. Ward; treasurer, W. F. Bagnall. Members of the council consist of J. E. H. Allbut, E. Houghton, W. F. Bagnall, J. H. Kain, R. W. Kemlo, H. Bagnall, and Messrs. Nivin, Crowther, G. Addy, Phillips, Sloper and Mainwaring.

TABLE OF ACCOUNTS

A PRODUCTIVE LABOR

1 All wages (day, piece, or premium) paid to the following when working directly upon production:
Molders
" Apprentices
Molding Machine Operators
Core Makers
" " Apprentices
Helpers or Laborers
Flask Fitters and Carpenters
Casting Cleaners

B METAL

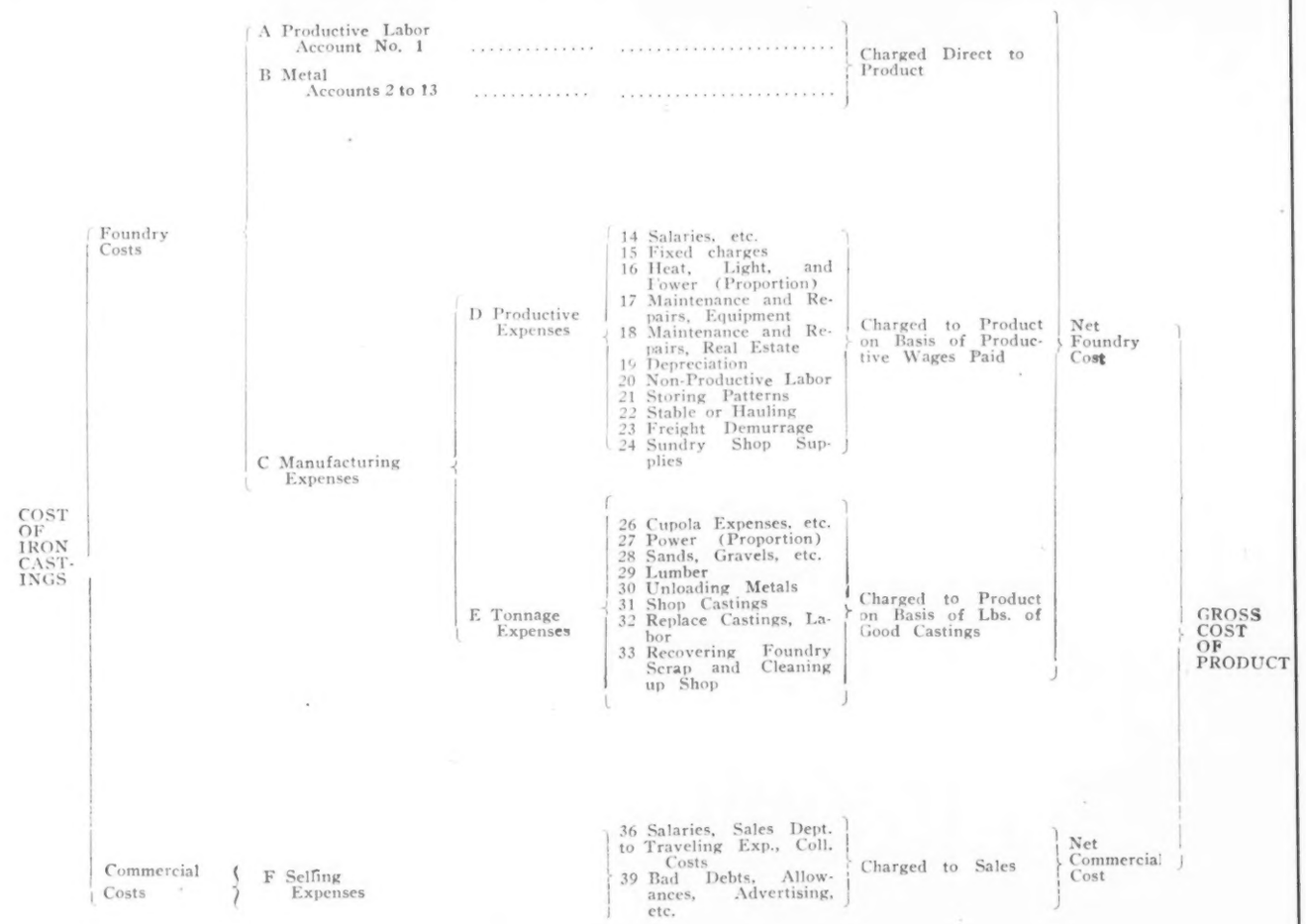
2 ..lbs. Pig Iron charged into cupola @.... $....
3 ..lbs. Bgt. Scrap " " " @.... ....
4 ..lbs. Fdy. " " " " @.... ....
5 ..lbs. Total Melt $....
6 ..lbs. Fdy. Scrap Recovered @.... $....
7 ..lbs. Defec. Cstgs. cond., in Fdy. ....
8 ..lbs. Total Scrap Recovered ....
9 (5—8) Gross Metal Used ....
10 ..lbs. Net Good Cstgs. (Inc. Core Rods) ....
11 (9—10) Loss in Melting
12 (Value of 9 ÷ lbs. of 10) = Cost of metal per lb. of Good Castings.
13 ..lbs. Net Good Cstgs. exclusive of Core Rods, Replace and Foundry Castings

D PRODUCTIVE EXPENSES

14 Salaries of Officers, Supt., Foreman, Chemist, Clerks, Watchman, Stationery, and Office Supplies.
15 Taxes, Fire and Liability Insurance, Rent or Interest on Investment, and all other fixed charges. (To be prorated monthly).
16 Light, Heat and Power (except where otherwise shown) including Electrician, and Crane Operators.
17 Maintenance or Renewal of Equipment.
18 Maintenance or Renewal of Real Estate.
19 Depreciation of Real Estate and Equipment. (Pro rate monthly.)
20 Labor of Patt. Maker, Carpenter, Blacksmith, or all other organization labor not applied direct.
21 Storing and caring for patterns.
22 Stable or Hauling Expenses.
23 Freight demurrage.
24 Sundry Shop Supplies.
25 Total Productive Expense—
25 ÷ 1 = Productive Expense Rate to be applied to direct costs in proportion to amount of direct wages paid on each.

E TONNAGE EXPENSES

26 Cupola Expenses—Including all labor and material on Cupola, and Ladles, relining, charging stock, etc., together with Fuel for Melting.


COST OF IRON CASTINGS
Foundry Costs
A Productive Labor Account No. 1 ....
B Metal Accounts 2 to 13 ....
Charged Direct to Product
C Manufacturing Expenses
D Productive Expenses
14 Salaries, etc.
15 Fixed charges
16 Heat, Light, and Power (Proportion)
17 Maintenance and Repairs, Equipment
18 Maintenance and Repairs, Real Estate
19 Depreciation
20 Non-Productive Labor
21 Storing Patterns
22 Stable or Hauling
23 Freight Demurrage
24 Sundry Shop Supplies
Charged to Product on Basis of Productive Wages Paid
Net Foundry Cost
E Tonnage Expenses
26 Cupola Expenses, etc.
27 Power (Proportion)
28 Sands, Gravels, etc.
29 Lumber
30 Unloading Metals
31 Shop Castings
32 Replace Castings, Labor
33 Recovering Foundry Scrap and Cleaning up Shop
Charged to Product on Basis of Lbs. of Good Castings
Commercial Costs
F Selling Expenses
36 Salaries, Sales Dept. to Traveling Exp., Coll. Costs
39 Bad Debts, Allowances, Advertising, etc.
Charged to Sales
Net Commercial Cost
GROSS COST OF PRODUCT

27 Power—Proportion of power for blowers, elevators, rumblers, pneumatic or hydraulic service to be estimated on horsepower basis or obtained by meter.

28 All Sands, Gravel, Facings, Coreroom Supplies, Chaplets, etc., Labor mixing facings and core sands, oven fuel, charcoal, etc.

29 Lumber for renewing or barring Flasks.

30 Unloading all materials, loading or charges on Refuse Dirt.

31 Labor and metal for shop castings, Jaggers, etc.

32 Labor on replace castings.

33 Recovering Foundry Scrap, Cleaning up Shop.

34 Total Tonnage Expense—
34 ÷ 13 (weight) = Ton. Exp. per lb. of good castings to be applied to direct costs in proportion to net wgt. of good cstgs. in each.

35 Total Foundry Cost—
1 + 9 + 25 + 34.

F COMMERCIAL EXPENSES

36 Salaries of Sales Dept. or Commissions paid.

37 Traveling or Incidental Expenses

38 Advertising, Catalogs, and other printed matter.

39 Allowances, Cost of Collections, bad debts, Int. on borrowed money.

40 Total Commercial Expenses—
To be distributed over sales.

41 Total Gross Costs—
35 + 40.

DISTRIBUTION OF EXPENSE, UNIFORM COST SYSTEM FOR JOBBING FOUNDRIES

COST SYSTEM FOR JOBBING FOUNDRIES

Uniform Method of Estimating and Distributing Costs Recommended by the Jobbing Founders' Association

THE REPORT of the cost committee of the Jobbing Founders' Association, organized in March, 1906, to formulate a uniform cost system for jobbing foundries, was presented at the December meeting of the Philadelphia Foundrymen's Association, held at the Manufacturers' Club, Philadelphia, by James L. Sterling, manager of the foundry of the Hilles & Jones Co., Wilmington, Del. This committee met from time to time during the past year and selected a rather composite system which embraces the best portions of a large number of methods considered. The services of a foundry cost expert were engaged to consolidate the different elements and printed blanks were prepared which cover every operation of cost system.

The report presented by Mr. Sterling is in part as follows:

It was decided not to attempt to change too much the detail matters of time keeping, billing, shop practice, as to how orders should be handled, etc., but to devote the principal effort to the proper division of the elements which constitute a complete cost, allowing each foundry to obtain details as best suited to its conditions. It was decided that the elements constituting the cost of the foundry product, as shown in the sheet showing the distribution of expense, were:

A—Productive labor.

B—Metal.

C—Expenses

the latter element being divided into three separate and distinct classes

D—Productive expenses, which consists of all such expenses as are practically fixed in their nature or not affected by the variations of the amount of production.

E—Tonnage expenses, which consist of all expenses which are directly affected by the amount of metal produced.

F—Commercial expenses, which are those directly connected with the sale of the product.

It was also decided that the most equitable way to distribute these various elements of costs was as follows:

A—Productive labor direct to the product.

B—Metal direct to the product.

D—Productive expense on the basis of productive wages expended.

E—Tonnage expense on the basis of tonnage or weight of net good castings made. The sum total of this distribution represents the net shop or foundry cost. The commercial expense F being disconnected with the actual production, it is recommended that it be distributed over the sales.

In order to show more clearly just which items we considered chargeable to productive and which to tonnage expense, we prepared a "Table of Accounts," showing the make-up of these various elements which can be subdivided into as many detailed accounts as may be desired, together with a chart showing the mode of assembling them.

Application of Cost System.

To use an expression made by one of the members of the committee, that "no cost system can be of any use unless used with judgment," is to express in a few words that neither this nor any other system can be absolutely depended upon to remedy all the evils of foundry mismanagement, but proper attention to the various elements of costs here shown, and which are those which comprise the costs of all foundries, will tend to eliminate the great factor of uncertainty now apparently prevalent in many if not all places of our business.

Our committee leaves to each individual the determination as to whether his cost keeping should be considered a part of his general books, but advises its being done. In interweaving this system with the general accounting, it would be necessary to carry a ledger cost account. In addition to the general ledger it will be found convenient to keep a subledger for the purpose of handling the various sub-accounts of foundry orders, metal, coke, sands, lumber and other supplies. In the sub-ledger each brand of pig iron, etc., has its separate account, which is debited with all purchases and credited as used.

HILLES & JONES COMPANY
FOUNDRY DEPARTMENT

SUPERINTENDENT'S ESTIMATE No.
DATE

I estimate the following Time and Material for making.

FOR

Drawing No. No. Required Approx Weight Each lbs
Patterns to be furnished by " Total lbs
To be Made in Loam-Dry Sand-Skin Dried-Green Sand-Machine

WAGES MATERIALS

For Patterns
Hours Patt. Makers @ cts. per hour
Feet " Lumber @ cts. per foot

For Patterns if purchased from

For Flasks or Fixtures
Hours Molders @ cts. per hour
" Core Makers @ " " "
" Helpers @ " " "
" Pitmen @ " " "
Lbs. Iron Reqd @ " " 100 lbs
Sundry Materials

For Molding, Core Making, Casting and Cleaning
Hours Molders @ cts. per hour
" " Helpers @ " " "
" Core Makers @ " " "
" " Helpers @ " " "
" Extra Helpers @ " " "
" Cleaners @ " " "

Proposed Approx Mixture % pig % scrap
Approx Net weight of casting lbs @
" Amount for Core Rods lbs @
" " " Gates, Runners, Etc lbs @
" Number of Bricks destroyed if Loam Work @

REMARKS

FORM 1—SUPERINTENDENT'S ESTIMATE SHEET

HILLES & JONES COMPANY
FOUNDRY DEPARTMENT

OFFICE ESTIMATE No
DATE

DESCRIPTION

	WAGES	MATERIALS	
For Patterns			
For Flasks and Fixtures			
For Making Castings			
For Machine Work			
For Other Charges			
For Freight Delivery at			
Shipping Weight lbs @ cts. per 100 lbs			
Add % for Expenses			
Add Materials			
TOTAL			

Price Quoted
Proposal No.
Accepted
Declined

ACTUAL COST
ORDER No.
WAGES
MATERIALS
EXPENSES
PROFIT OR LOSS
RECEIPTS

FORM 2—OFFICE ESTIMATE SHEET

The System as Applied.

With no desire to intrude any personal features into this subject, but merely to show how this system can be adapted to a general jobbing foundry business, I will present some of the various printed forms used by the company with which I am connected, and the extent to which we go into the details of our costs.

Let us assume that we receive an inquiry together with a blue print for a casting. This print is handed our superintendent, who makes out an estimate of the time, etc., necessary to produce the casting. This form, No. 1, is given a consecutive number and provides, first, for a description of the proposed casting, number required, weight of each, pattern data, if to be furnished us or an estimate of the cost if we make it, estimate for fixtures, special flasks, and time for molding, casting and cleaning, approximate mixture, approximate weight of core rods, runners, gates, etc. This estimate then comes to the office, where the office estimate sheet, Form 2, is prepared, and includes expenses, freight and other charges.

Orders.

When an order is received it is given a progressive number, the orders being divided into three classes—

F—Orders covering castings for sale to customers.

E—Orders covering equipment work.

THE HILLES & JONES COMPANY, ORDER No.
FOUNDRY DEPARTMENT
WILMINGTON, DELAWARE DATE

FOR

THE FOLLOWING | RECORD OF SHIPMENTS

CUSTOMER'S ORDER No. | SHIPPING INSTRUCTIONS
CUSTOMER'S REQ'N No.
DATE OF ORDER
WHEN RECEIVED
TO BE COMPLETED
PRICE AS AGREED TO BE
ESTIMATE No.
PROPOSAL No. | FREIGHT CHARGES

FORM 3—ORDER BLANK

R—Orders covering replace castings.

These are made out by our stenographer in quadruplicate and are as shown in Form 3. One copy is sent to the superintendent, one to the shipping clerk, one to the cost desk and the other is placed in the office order book and is considered the original.

The shipping clerk is also responsible for the proper marking up of the various patterns, gummed labels being used for this purpose.

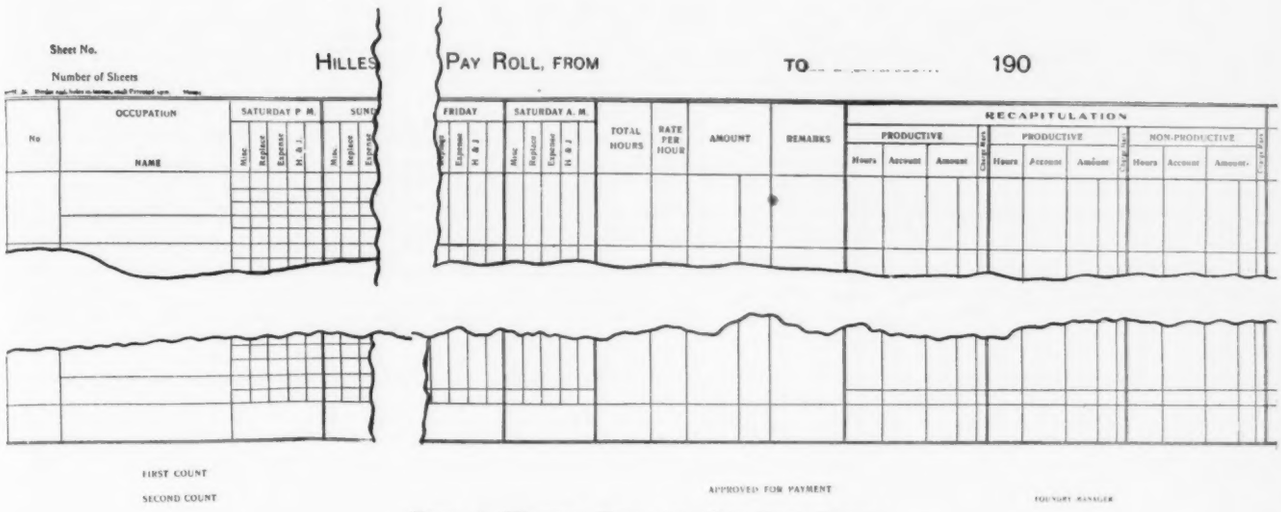
Time and Pay Roll Sheet.

Our weekly time and pay roll sheet, Form 4, becomes a book of original entry and is what is usually called a "balancing pay roll," so called for the reason that the sum total of all charges in the recapitulation columns must exactly agree with the sum of the total wages paid. It is subdivided into days, and each day into charging columns representing those accounts most generally used. The time of each employe is collected by the time-keeper and entered by him in its proper column, the total number of hours at the respective rates counted out and recounted and placed in the total column. The time is then recapitulated, productive labor being put into the productive column and non-productive in the non-productive column.

Our cost sheet especially provides for the proper entries to cover every element which enters into the cost, together with each sale made. All charges for time to the various costs are made direct from the pay roll to the several cost sheets, one or more being taken out for each order. At the end of each month the various entries covering expenses are made on these sheets, both productive, which are applied by a per centum factor of productive wages paid and tonnage, which is applied in cents or mills per pound of castings.

Heat Sheets.

As the timekeeper collects the time from the various men, he also takes up the heat, ascertaining just how many pieces of each pattern are made by each molder. This heat sheet, Form 5, is passed to the shipping clerk, who follows up every heat and finds out what castings are good and those that are bad. If any are bad he issues a replace or "R" order covering them and marks the pattern up accordingly. This heat sheet remains with him until delivery is made of the castings, making a note of delivery by means of a rubber stamp showing the date delivered. By this



FORM 4—WEEKLY TIME AND PAY ROLL SHEET

sheet we are able to obtain a complete history of any particular order, to ascertain by whom the various castings covered by any order were made, the number defective, the daily average of each molder with the amount of bad castings made by him, together with the reason why castings were condemned.

Sales Reports.

The sales reports, Form 7, are also numbered consecutively as a check for the bill clerk in invoicing, all numbers having to be accounted for. On these slips we show the various items, pattern number, our order number, customer's order and requisition numbers, weight, rate, and amount, with check columns for office use. These are always made out in duplicate, the duplicate becoming a manifest or delivery memorandum for the customer. The foundry memorandum is removed from the copy sent the customer, but the original, which is retained in the office, is used for the purpose of checking up deliveries in the various order books, and for noting that the article had been regularly entered upon the cost sheets.

As monthly reports for comparison, we make summaries of our cupola reports, Form 6, which show amount melted, ratio of fuel to metal, number of and average size of each heat, proportion of pig and scrap, percentage of loss in melting, pounds of good and bad castings, cost per pound of good castings made for all metals used, expenses which we divide into such items as shown on the table referred to heretofore, proportion of productive to non-productive hours, summary of all costs, showing the profitable and the unprofitable jobs at a glance, and on our own work, showing cost per pound for productive wages, productive expenses, tonnage expense, core rods, fixtures and metal.

We close our books every month, taking off a regular trial balance and statement of assets and liabilities, showing accounts receivable and when due, as well as accounts payable.

Metal Account.

For convenience, and to be able to keep properly in touch with our various lots of metal, we abandoned the brand name and substituted an analysis number. Each car of iron as soon as received is separately piled, numbered, sampled, and analyzed, and thereafter that particular pile is not known as No. 1X Crane or Thomas, but as No. 126, or whatever its analysis number is, and as No. 126 it is weighed and charged into the cupola and reported on the daily cupola report. At the end of the month, if this entire pile is used, No. 126 in the sub-ledger should balance itself. If it does not balance we force it by either debiting or crediting the difference so that we include the total number of pounds and total value as purchased and paid for in the cost of metal. This same "overs and shorts" method is used in charging all of our various supplies. By this method we are able at any time to inventory our stock.

Too much cannot be said of this method with the expense materials, such as sands, gravels, etc., which are affected by moisture, as it is necessary to know that every dollar expended for them has been charged to expenses. With these articles we endeavor to keep daily and monthly records of what is used, making subledger entries and expense charges at the end of the month, verifying the inventory by estimating when the material has not all been used and by arbitrarily charging or crediting when the bins are empty or approximately so.

All core rods are weighed each day

HILLES & JONES COMPANY

FOUNDRY DEPARTMENT

Report of Castings Poured on 190

MOLDER	No. Pieces	Description or No. of Pattern	ORDER No.	No. Good	No. Bad	Weight Good		Weight Bad		REMARKS
						H. & J.	Outside	H. & J.	Outside	

FORM 5—HEAT REPORT

HILLES & JONES COMPANY
FOUNDRY DEPARTMENT

DAILY CUPOLA REPORT. DATE_____190

CUPOLA NO.	WOOD CORDS	COAL LBS.	COKE LBS.	FLUX	ANALYSIS NUMBER	ANALYSIS NUMBER	ANALYSIS NUMBER	ANALYSIS NUMBER	ANALYSIS NUMBER	STEEL SCRAP	FOUNDRY SCRAP	CAST SCRAP	TOTAL	REMARKS
1st Charge														
31st "														
32nd "														
TOTALS														

Blast in oz. Lighted at Blast on at Bottom dropped at Length of heat

Ratio of Fuel to Iron, 1 to Iron melted per hour Avg. Mix % Pig % Scrap

Amount used for Pigs and Rods
" Flasks
" Gates and Runners
" Pig Bed

Good Castings Produced
Bad
Foreman

ANALYSIS OF PIG IRON USED

ANALYSIS NUMBER	SILICON	SULPHUR	MANGANESE	PHOSPHORUS	GRAPHITIC CARBON	COMBINED CARBON

TESTS OF BARS

NO. OF BAR	TRANSVERSE	TENSILE	REMARKS

FORM 6—DAILY CUPOLA REPORT

and the weight charged to the respective orders. The labor of making them is considered productive and as such is charged direct to the order. The metal is charged at the monthly rate of "Cost of Metal" and the job is credited with the scrap value.

Foundry Scrap.

All gates, runners, sprues, etc., are gathered up as far as possible each day, particular care being taken to clean up at the end of the month and the "Foundry Scrap Account" is charged with them, cost of metal being credited at a price determined in accordance with the market price of bought scrap. When used over again this sub-ledger account is credited and it again enters "Cost of Metal."

Bought scrap is another sub-ledger account, being charged with all purchases and credited with amounts as reported from the cupola. This same evening-up process is used here as before described, though owing to its nature it is more dependent upon estimate than the other commodities.

Condemned Castings.

These are divided into two classes, those which are condemned in the foundry before entering into sales, and those returned by customers. The former class is treated as foundry scrap, the latter as bought scrap. In both cases the cost of making the replace casting becomes non-productive labor and is charged to expense.

The metal of this replace casting, which becomes a "sales" is charged to the original order at the "Cost of Metal" price. Here we admit a certain inequity, as the first casting, if condemned in the foundry, does not specifically reach the sales, but is taken up in the "Cost of Metal," whereas if it is condemned after delivery, the original order has to stand the cost of metal on the replace casting, as well as the difference between the original cost of metal price and the scrap value of the returned casting.

We deem it correct to consider the cost of making replace castings to be an expense of the operation of the foundry and not a legal charge to the direct production of the order. However, we admit that in certain classes of work there is more chance of having defective work than in others, but we contend that this condition is one for consideration in the acceptance or rejection of an order and in the price consideration. Here will be found one of the applications of the use of costs with judgment, to know that certain work is more hazardous is to know that your expense rate will be affected to a greater or less degree by the amount of bad work made, and if comparisons are continually made of expense sheets, the man responsible for the output will naturally be on the alert to exercise all precautionary measures to avoid these losses.

Equipment.

All expenditures for additional standard equipment belong to the capital account and are a proper charge to it at cost value. All renewals to equipment are chargeable to productive expenses, or if any equipment is abandoned or sold, the capital account should be credited and expenses charged the full amount less the scrap or sales value.

Regarding special equipment for the production of any particular orders, such as loam plates, special flasks, bars, etc., the proper and only place to charge them is to the order for which they were made, crediting this order with their scrap value upon completion.

Stock Cores.

These should be considered a store room article to be charged per piece as used, or if the character of work done is constant or approximately so,

WILMINGTON, DELAWARE. 190

SENT BY HILLES & JONES COMPANY FOUNDRY DEPARTMENT

SHIPMENT NO. TO

VIA.

FOUNDRY OFFICE MEMORANDA

TO REMAIN AS OFFICE COPY

No. Pieces	ITEMS	Pattern Number	Foundry Order No.	Customer's Order No.	Customer's Req. No.	WEIGHT	Charge (a)	AMOUNT	Checked 1 2 3	Invoice No.	Entered on Cost

FORM 7—MANIFEST OF SALES

it should be considered as a portion of tonnage expenses and so prorated on all orders.

This system, being elastic, is capable of being divided and subdivided into many details, or of being condensed into few generalities. If it is found desirable to know the cost per pound or the cost per productive hour of the molding, coremaking, c'eaning, etc., it can easily be done. If it is desirable to know how much per pound of net good castings sold it has cost for any one of the numerous expense items it can as readily be done and a careful compilation of these details for comparison from month to month will enable one to place his finger upon leaks or apparent wastes. It can be applied to each individual order or to various classes of castings and will be found elastic enough to cover any desired feature.

The attainment of costs does not effect any economy in current production, but it does directly effect profits by showing where losses have occurred, either in the too expensive cost of production, or too small amount received for the product, and is invaluable as a record for future guidance. With this system it is possible to discover just which of the various classes of work are profitable and which should either be raised in selling price or passed on to a competitor, and also to keep track of the efficiency of men and organization.

Different foundries will have different ways of attending to the details of their business and upon these detai's we do not presume to pass judgment, but merely present for their consideration this system which provides for the covering of all expenditures incident to the production of castings with the principal desire that ultimately, and if possible in the very near future, we may each and all realize what constitutes our costs, and in realizing have backbone enough to turn down an order which our judgment or records show would incur a loss.

If this is accomplished and we compete for work, each will feel that the other is estimating upon the same work from the same standpoint of as nearly accurate costs as seems possible.

Estimating for new work is probably the most particular element in the management of our business and the most particular element in estimation is to be sure that every item in the cost of production has been included.

We, in the foundry business, are compelled on strictly new work to rely upon the judgment of a guesser, sometimes good, sometimes bad. Where the same thing has been made before and the former cost is before you, it is somewhat simple, but even then, due to the fallibility of man, the cost may be incorrect and a careful examination of it should be made. "A good guesser is much more to be desired than a poor estimator," therefore particular attention should be given this work. We beileve that the proper way to prepare an estimate is to have printed forms calling for every class of work or expenditure, the use of which would seem to make certainty doubly sure. In the use of expense ratio in estimating, judgment should be used in taking as a factor a rate which covered a period as nearly similar in conditions as possible, bearing also in mind the effect the proposed work might have upon the conditions then existing.

HILLES & JONES COMPANY — SUMMARY OF COST — ORDER NO.

FOUNDRY DEPARTMENT — ESTIMATE NO.

WILMINGTON, DELAWARE — DATE ISSUED

DATE COMPLETED

FOR

CHARGES	ACTUAL WAGES AND EXPENSE	ACTUAL MATERIAL	ESTIMATE AMOUNT	ESTIMATE HOURS	TIME	ACTUAL HOURS
FOUNDRY CHARGES					Hrs. Patternmakers	
Productive Wages					" " Appr.	
Expense (Prod. Labor)					" Moulders	
" (Tonnage)					" " Appr.	
Iron for Castings Lbs.					" Mold. Machines	
Lumber for Patterns Ft.					" Coremakers	
Fixtures less Credits for Returns Lbs.					" " Appr.	
Miscellaneous Items					" Fitters	
					" Cleaners	
OUTSIDE CHARGES					" Helpers	
Hilles & Jones Co.					" Forge	
Invoice Purchases					" Carpenters	
Pattern "						
Freight Lbs. @ 100 Lbs.						
TOTAL						

Cost Including all Expenses — Received for same — Profit

Cost Per Pound — Received Per Pound — F. O. B. — Loss

FORM 8—COST SUMMARY

HOW ARE CAST IRON BORINGS MELTED IN A CUPOLA?

By W. Binns

When I secured my copy of THE FOUNDRY for October and read the opening article "Melting Iron for Castings," I was very much interested in learning how the practice therein set forth compared with and differed from my own, and that with which I have been familiar.

There is one thing which the article brought to mind and about which it gave no definite information. In Table IV, in showing the various fuels used and the proper way of keeping track of them with their analyses and costs, cast iron borings were mentioned. I am not certain that the table is taken from Mr. Stoughton's own practice but if it is not I should judge that it at least is meant to represent conditions such as usually exist, or which should exist to give the man in charge a fair chance to get good results at a reasonable cost. I looked over the example which he gives of the way to figure the charge hoping to see how he used the cast iron borings but was disappointed, as it was not part of the material used.

Where a foundry and machine shop are owned by the same party, and the machine shop is working up the castings made by the foundry there is always a large amount of cast iron borings. Under this head I class all kinds of cast iron chips, and as they are made from the castings of a reasonably well known composition it would seem to be a safe thing to use them, if they can be used successfully in a cupola. It would seem as though they would be available as scrap and go in in place of some of the outside scrap which has to be bought, and is often hard to get.

The question of scrap is a vexatious one at best. Notwithstanding the high price which often has to be paid, it is of unknown composition. The best that can be done is to guess at its analysis, or rather to guess at an average as to what it should be, and then trust to luck that the guess is near enough to the truth to not bring evil results. If all of the cast iron chips made in working up the castings could be used in the foundry in place of the same quantity of outside scrap it would greatly reduce the percent-

age of the uncertain element. In the table shown, about 7 per cent of the material is cast iron borings, and I would like to know how to use them and get the benefit of the good iron they contain instead of selling them to some dealer for very much less than the cost of other scrap.

If Mr. Stoughton is engaged in foundry work and is making use of cast iron chips as a part of his regular foundry charges, or if he knows of anyone else who is I am sure he will find many interested in knowing how it is done.

My own experience has not been very extensive, but it proves that I can burn up quite a lot of chips in a cupola without doing any harm to the rest of the charge and without doing any good in the way of getting iron from them. It has been claimed that they can be successfully used, and if any reader of THE FOUNDRY is where they are being regularly charged it should not be hard to get at the facts. There is no doubt that they can be charged into the cupola in small quantities and then lost track of, and it may be that they can be charged in in large quantities but unless they appear at the spout as melted iron it may be better to continue to sell them to the dealer.

I may as well confess that in a way "I am from Missouri." I am not very old at the foundry business, and yet have not been able to make many things work that were guaranteed to do wonders in the way of improving iron and making it free from imperfections. It is not because I have not been willing to try things, and so it must be that I am not very proficient in following up the ideas of others. I mention this so that whoever tells us about how to use cast iron borings will do it so carefully that I will be able to get all of the points and be able to do it also. That is the object I have in view in wanting some one to enlighten me. I want to be able to use up all of our chips and to feel that I am making money in doing so.

HILLES & JONES CO.

FOUNDRY DEPARTMENT.

REPORT OF EMPLOYEES FOR

CLASS	AT WORK	OUT	NEW	OFF	TOTAL	DETAIL OF CHANGES
Office						
Supt. and Foreman						
Watchmen						
Power Plant Engineers						
Teamsters						
Pattern Makers						
" " Appr.						
Carpenters						
Flask Fitters						
Electrician						
Blacksmith						
Sand Mixer						
Loam Molders						
Sand "						
Bench "						
Apprentice Molders						
Machine Operators						
Foreman Core Makers						
Journey " "						
Apprentice" "						
Chippers and Cleaners						
Laborers and Helpers						
Cupola Hands						
Crane Operators						
Brass Molders						
NIGHT GANG						
Laborers						
Crane Operators						

FORM 9—DAILY REPORT OF EMPLOYES

WHITE METAL FOR PATTERNS.

Question:—We would like to have mixtures suitable for making white metal patterns.

Answer:—A selection may be made from the following:

(1) Tin, 12 pounds; antimony, 1 pound.

(2) Tin, 10 pounds; lead, 6 pounds; antimony, 1½ pounds.

(3) Zinc, 10 pounds; genuine Babbitt, 10 pounds. This will make harder patterns than the other two mixtures given. Scrap pewter also makes a very good pattern alloy.

AMERICAN BRASS FOUNDERS' ASSOCIATION.

The executive board of the American Brass Founders' Association has voted to hold the first convention of this organization at Toronto, Canada, during the first week in June, next year, at the time of the meeting of the American Foundrymen's Association. The Brass Founders' Association now has a membership of 110, and is increasing steadily. Those interested in the use of the non-ferrous metals are invited to join this organization, and can secure membership blanks from the secretary, Andrew M. Fairlie, Box 197, McCays, Tenn.

TRADE PUBLICATIONS.

GRINDERS.—Cincinnati Electrical Tool Co., Cincinnati. Bulletin No. 5 describes the direct-current grinders built by this concern. These tools are adapted for a great many purposes where electric current is available and can be attached to any ordinary incandescent lamp socket. The grinders shown are of four different types.

GRAPHITE.—The December number of *Graphite,* published by the Jos. Dixon Crucible Co., Jersey City, is devoted to a description of the recent street railway convention held at Atlantic City. It also contains many halftone illustrations showing the principal points of interest at this great American watering place, as well as the Dixon graphite exhibit.

STEEL FACTORY EQUIPMENT.—Kilbourne & Jacobs Mfg. Co., Columbus, O. Sixteen-page booklet describes and illustrates factory equipment manufactured by this concern, including pressed steel shop pans, riveted tote boxes, steel barrels, and trucks.

MOLDING MACHINES.—The Killing Molding Machine Co., Davenport, Ia., is mailing to the trade a 6-page bulletin which describes the Killing roll over straight draw, stripping plate, and straight drop molding machines, as well as the steel snap flasks made by this concern.

PYROMETERS.—The Bristol Co., Waterbury, Conn., has issued three bulletins covering its electrical instruments. Bulletin No. 61 contains 12 pages, and describes voltmeters; bulletin No. 62 describes recording ammeters; and bulletin No. 63 covers a line of recording wattmeters, and contains 19 pages.

METALS IN FOUNDRY PRACTICE

Questions from Practical Foundrymen are answered in this department by the following experts

CAST IRON	W. J. KEEP
MALLEABLE IRON	DR. RICHARD MOLDENKE
METALLURGY OF STEEL	J. B. NAU
STEEL CASTINGS	W. M. CARR

OTHER EXPERTS ALSO CONTRIBUTE — ADDRESS ALL INQUIRIES TO THE EDITOR

CAST IRON NOTES

BY W. J. KEEP

QUESTION:—We are having considerable difficulty with cast iron tablets which show scarred surfaces after they have been sand blasted. When they leave the sand the surface appears practically perfect, but after the sand blast has been applied the defects appear.

Answer.—Your difficulty seems to result from defective molding. More attention should be paid to the tempering of your sand, which should be neither too wet nor too dry. Do not sponge the edges of the gates. If run with a flat sprue, paint the gate with silver lead on the cope side, but do not paint the face. If it is desired to face the casting shake on one-half silver lead and one-half talc. Shake just enough charcoal facing to keep the pattern from sticking. From the appearance of the photograph it seems that too much facing had been used and that it had washed. If the drag was rammed too hard under the sprue the iron would boil and cut the surface of the mold. Vent the mold thoroughly and it might be suggested that an effort be made to make the mold without facing. A number of years ago I saw a mold made in an English foundry from a pattern on which the letters were very close together, very deep, and there was little draft. In rapping the pattern nearly all the sand between the letters came loose and would have washed before the iron. The molder pushed each core into place and then sifted powdered resin over the whole surface. A hot plate of iron was then held close to the letters until the resin melted and soaked into the sand. When the mold cooled every particle of sand was firm and the resultant casting showed no defects. The use of the sponge would have done little good and would have resulted in blowing. In this instance there may have been some loosened cores which were sponged and resulted in this condition.

DULL IRON.

Question.—We are having some trouble with dull iron, but cannot locate the difficulty. We use a cupola lined up to 41 inches. Our blast gage only shows a pressure of 2½ ounces. The cupola has only one row of tuyeres.

Answer.—Undoubtedly the cupola that you are using has its tuyeres expanded at their inner ends to form a nearly continuous tuyere system. If the top surface of your bed charge of coke were over 18 inches above the top of the tuyeres and the other charges were in the proportions of 1 pound of coke to 10 pounds of iron, then the trouble is with the blast. The size of the blower at its regular speed should be such that you would have at least 10 ounces pressure, while 14 ounces would be required at the middle of the heat. It will be less at the beginning and end of the heat, but should never be below six ounces.

THREE KINDS OF IRON FROM ONE CUPOLA.

Question.—Is it practical to take three different kinds of iron out of one cupola when the melt does not exceed seven tons? We would like to run a very hard iron, a medium iron for ordinary castings and a soft iron for gears. Medium iron is for ordinary implement castings, the hard iron for plow points, mold boards, and other similar castings. How should the cupola be charged to accomplish this?

Answer.—Charge your hard iron first using as many charges as you require. Then follow this with as many charges of medium iron as you want, last of all a soft iron. You can calculate by the number of ladlefuls that you have tapped out when you are through with each kind of iron, but it is advisable to use the iron near the end or the beginning of a charge for castings, where a little variation will cause no trouble. If you make the coke charge between the various kinds of iron larger than the others, a few seconds will intervene when the iron will run slowly, but this occurs only when you draw off the iron as rapidly as it melts. In fact, you could not possibly make a success of this method unless you tapped out the iron as fast as it is melted. You can also ascertain when the iron changes by the appearance of the stream at the spout and its motion in the ladle. You could soften some of the iron at the end of a heat by adding a small portion of 50 per cent ferro-silicon.

USE OF MALLEABLE SCRAP FOR GRAY IRON CASTINGS.

BY RICHARD MOLDENKE

From the canal zone comes an inquiry regarding the use of malleable scrap from discarded rolling stock, for gray iron castings. This class of scrap should really only be used for making annealing pots, or other castings intended for containers subjected to severe and long continued heat. In the malleable foundry, this material, when heavy, forms a much desired constituent of the mixture.

Since our correspondent, however, states that he uses but little scrap for his daily 8 to 10-ton heat, there is no reason why up to 10 per cent of this malleable scrap may not be used. The silicon of the pig iron must be taken sufficiently high, and malleable scrap had better not be figured as containing more than 0.40 per cent silicon. Furthermore, a greater

amount of coke than usual should be charged, as in melting malleable scrap, unless plenty of fuel is available, the metal will be oxidized badly before getting into the ladle.

As a general proposition malleable scrap in the mixture will give results similar to those obtained by adding one-fourth the quantity of steel scrap.

CAST STEEL GEAR BLANKS.

By W. M. Carr

Inquiry:—We cast a large number of steel blank gear wheels, the rim being solid, the teeth being later machined. We find that they contain many holes after the teeth are cut. The holes show up largely where the rim pins the arms.

Answer:—The difficulty seems to be one of improper feeding or excessive shrinkage. Were the trouble due to wild or gaseous steel the holes would not be confined to certain spots. This trouble may be overcome by a liberal use of risers at the points where the holes commonly occur. They should not be necked or reduced in cross section where they unite with the casting. It is common practice to neck a riser for the purpose of cutting it off easily. The steel will chill sooner at the neck than above or below this point and will prevent the more liquid metal above from flowing down into the casting. Under such conditions shrink holes are liable to appear when the riser is removed. Would further suggest that you pour fresh hot steel directly into the risers in preference to allowing them to fill up entirely with metal that has passed through the gate in the mold. When the metal reaches the risers in this way it has lost much of its fluidity and the proper feeding effect of the riser is more or less weakened. If the steel for the casting referred to is made by the Tropenas process, pour in the usual manner, stopping the gate flow the moment the metal appears at the lowest point of the risers, and then fill them with hot fresh steel.

FREEZING OF MALLEABLE IRON.

By Richard Moldenke

Question.—We have a small reverberatory furnace which melts in about three hours ordinarily, but for some reason which we have not been able to discover there seems to be a back draft in the stack, due, we believe, to atmospheric conditions, but inasmuch as this only happens once in three or four months, it seems as though something else must be wrong. The melting conditions are exactly the same as when the furnace operates under normal conditions. Recently the iron was ready to tap and was as hot as could be desired, when it cooled suddenly and it was impossible to pour it. We were unable to reheat it on account of the draft. We are using a No. 5 Buffalo pressure blower, with a 10-inch pipe. Not having had any experience with the volume blower, we would like to have the experience of some along this line. With our blower we can blow the fire over the bridge wall, therefore we do not use it at its full capacity. Would a volume blower solve our troubles?

Answer.—The phenomenon described is one that is a mystery to the maker of malleable castings. The iron is as hot as one can desire, it is tapped into hand ladles, and pouring is attempted. A little gets into the molds, leaving them short-poured, the ladles going back to the furnace heavily skulled. More iron is tapped into the ladle to remelt the metal that has set. Instead the next return from more short-poured work is an almost solid ladle, and haste is made to get the heat on the floor as quickly as possible to save the furnace.

Our correspondent, having this trouble only occasionally, asks whether a back draft in the chimney, together with the use of a pressure blower instead of a volume blower might be the cause. This can hardly be the case, though perhaps there are conditions existing in the arrangement of the air supply or furnace construction, which might leave matters just on the danger line during the heat. Then, if the firing is not done just right, this occasional trouble will occur.

The difficulty is simply the burning of some of the iron in the bath. Investigations that I have conducted have proven to my own satisfaction that the presence of as little as 0.03 per cent of oxygen in a bath of malleable is sufficient to ruin it for casting purposes. It was after a number of such heats, made in an open-hearth furnace, however, all of which showed the phenomenon above described, that a chemical investigation for oxygen was made, the rest of the composition being all that could be desired. This oxygen comes from the solution of the oxidized iron in the bath, and may be the result of a direct burning of the metal through overheating in the first place, or the result of a strong blast of air on the surface, similar to bessemerizing. Or, most likely, the end of the bath, near the chimney, may be very shallow, feathering out to a line, and this metal, when overheated, will quickly be badly burned, and mixing with the rest of the metal, contaminates it all.

Iron containing dissolved oxide has a higher melting point than the normal metal, and while appearing very hot in the furnace, and on tapping runs well, the moment it strikes the hand ladle and is thus cooled, even only slightly, it is sufficient to cause skulling. Dead iron of this kind means burnt iron.

Now for the solution. First observe the action of the blast, that the portion over the bridge wall is not too strong and direct. Next see that there is no feather edge at the throat end of the furnace. Build up the sand there to leave your bath several inches deep. Round the throat of the furnace leading up into the chimney, so that the sweep of the flames is direct and does not have to make a turn upward at right angles, passing a sharp corner. This will prevent a swirl of gases, and give better value to the chimney. This should attend to the danger line now existing. If bad heats of this kind are again encountered, it is best before tapping out the iron on the floor, and using it for succeeding heats and correspondingly damaging them, to add enough ferrosilicon (high grade) to improve the quality of the metal—about 10 to 20 points silicon—then pour out, and use in the following heats. If this is done, no trouble will be experienced from bad iron.

SUBSTITUTE FOR SAL-AMMONIAC IN ANNEALING SCALE.

By Richard Moldenke

Inquiry.—Kindly advise us what material can be used to take the place of sal-ammoniac in oxidizing iron scale for packing castings for annealing.

Answer.—I have made about 100,000 tons of malleable using sal-ammoniac in preparing the scale, and about 125,000 tons without using it, and have yet to see the difference. Like many other things in the business, custom is a big factor. In its best condition the scale should be about half pea-size, but should contain no dust. Hence an occasional screening of the scale from its dust, and throwing the latter away, as it is full of silica, will leave the scale in good condition. A malleable works using iron annealing pots has no business to buy scale after the first year. The flakes coming from the pots themselves is the very best material for annealing purposes. Stamp it small and keep adding to the scale. Occasional elimination of the dust is all that is necessary.

It may also be interesting to know that it is perfectly possible to anneal malleable by using either sand or fireclay for packing purposes.

DISCUSSION OF FOUNDRY PRACTICE

Consideration of Foundry Problems at the Annual Meeting of the American Society of Mechanical Engineers

TWO OF THE sessions of the annual meeting of the American Society of Mechanical Engineers, held in the Engineering Societies building, New York, Dec. 3-6, were set apart for the consideration of foundry practice exclusively. A large number of excellent papers were presented and the ensuing discussions were vigorous and animated.

The first session for the consideration of this topic was held on Thursday morning. The discussion of a paper by W. A. Bole, of Pittsburg, entitled "The Foundry Department and the Department of Engineering Design," was largely concerned with the size of the fillet, several speakers citing instances where weakness had resulted from too great a body of metal. Mr. Kleinhans stated that better steel castings are secured by increasing the size of fillets up to the point where piping sets in. Another speaker told of an investigation of a fly wheel explosion, where an extra heavy fillet had resulted in shrinkage of iron into the rim, causing a large pocket at the point of juncture. The same experience in similar instances led to the cutting down of the mass of metal, thus removing the difficulty. In the manufacture of pumps the use of a heavy fillet frequently led to the dead partition in the center being extremely porous and eating through in a short time. This was avoided by casting a 1-inch head with a grillage of 1-inch bars, the resulting casting lasting four or five times as long as one with the heavier head.

Mr. Johnson told of a pulley of 3-foot diameter, 2-inch rim, which, when turned down rather thin, showed plainly seams of spongy metal on each of the six arms. Occasionally in chill castings a diagonal line can be traced from the bottom of the chill up and in cases of extreme crystallization a pin can sometimes be inserted in the openings. Mr. Williams told of putting on a riser to overcome the shrinkage difficulty in the casting of gear wheels. Mr. Lane said that, where a fillet is absolutely necessary, a chill can sometimes be applied at this point with good results. In cast iron or steel, he said, the skin is not so flexible; it sets first and later shrinkage is to the skin and not toward the core, though the reverse is true with many alloys. The importance of keeping sections of large castings even and of uniform thickness, so that metal will not be drawn from the heavier sections in cooling, was emphasized by several entering into the discussion.

Molding Sand.

In the absence of the author, Secretary Rice presented by abstract the paper on "Mechanically Treated Molding Sand," prepared by Alexander E. Outerbridge Jr., which was published in the December issue of THE FOUNDRY.

E. H. Mumford told of two classes of treatment, either putting the sand through a reciprocating riddle or turning it over with a shovel, and the rubbing of the alumina of the sand into the individual grains of silex. With the former, the effect is noted that, varying with the speed, the tendency is, because of the particles all rolling in one direction, to cause the alumina to gather in small nodules. The crystals become bare and the sand thus loses its bond. Good results, the speaker said, are secured from the centrifugal mill by the impact or "throwing together" method.

Speaking of core sand a member referred to a case where a foundryman installed a clay grinding mill for the grinding of his core sand. He is able to re-use about 90 per cent of his old core sand and finds he can reduce his dry core compound by 50 per cent. Instead of bond sand, he uses ordinary bank sand and secures cores which are extremely regular, burn evenly and come out well. He is also securing heavy economies, having paid for the cost of installing the machine by the savings of 8 or 10 months. The speaker further stated that this course is impractical for cores of less than 2 inches diameter. For 1-inch cores linseed oil and sharp sand are employed and for very fine cores an expensive liquid compound is utilized. The grinding mill is employed only for the larger sizes. By grinding the sand thoroughly, continued the same speaker, "they get it on the corner of the crystals." The decreased amount of bond required renders the core extremely porous.

Power Service in the Foundry.

A paper on this subject, read in abstract by A. D. Williams, of Pittsburg, called attention to unusual possibilities in the line of power service for obtaining maximum production, and suggested a number of openings for important improvements, one of the most important being the giving of greater consideration to the crane service of the foundry.

A lengthy discussion was provoked by a contribution of Mr. Richards, challenging certain statements of Mr. Williams in regard to the efficiency of compressed air in its ease of distribution through pipes. He recited details of its successful use in connection with the building of the Pennsylvania tunnels and stated that at the Phillipsburg plant of the company he represents all power is transmitted either by electricity or compressed air. At the Amherst quarries of the Cleveland Stone Co., he declared, there are 9 or 10 miles of compressed air pipes and pressure is maintained over night without difficulty. In the New York tunnel work there have been employed 80 air compressors, with a combined capacity of 190,000 cubic feet per minute; they have been at work constantly night and day, Sundays included, and have set new speed records.

Mr. Mumford, though stating that he was not criticizing compressed air or the air compressor, commented upon the fact that the leak in one of these pipes is a subtle one, hard to locate, and that leaky valves are liable to prove a source of trouble. Another speaker said that because of lower pressures and the absence of expansion and contraction leaks are not so common as with water or steam pipes. Mr. Johnson told of a 5-inch compressed air line 8,000 feet

long at his plant, which gave practically no trouble; it is equipped with long sleeve couplings and expansion joints. He thought the chances of keeping the steam or air line tight, and in good shape were 10 to 1 in favor of air. Mr. Ronceray spoke of the availability of water pressure to molding machine work.

A Volumetric Study of Cast Iron.

The concluding paper presented at this session, a discussion on the above subject by Henry M. Lane, of Cleveland, was illustrated by a number of lantern slides, which were explained by the author. The usefulness of a number of charts shown was largely destroyed by errors in drawing, resulting in the proportions of impurities to the volume of iron not being correctly maintained. The paper dealt with the author's discoveries regarding the volume occupied by impurities in cast iron, dealt also with malleable castings and compared gray iron castings with wrought iron.

The ensuing discussion brought out a very general disinclination to accept the theories set forth by Mr. Lane. Mr. Johnson, the first speaker, said that both in theory and practice the paper was absolutely in error so far as malleable castings were concerned. Carbon can penetrate through iron, he continued. The only part of the malleable casting which is worth anything is the outside skin, which is decarbonized. The casting otherwise might almost as well be hollow, except for the opposition offered to collapse. Volumetric study, he concluded, was without basis, except so far as it concerned the graphitic carbon in cast iron.

Mr. Lane was questioned in regard to the nature of the pickling bath in which several small castings entering largely into his discussion had remained a number of months. He said it was very dilute hydrochloric acid, about a 1 per cent bath. Mr. Keep said this acid was used to take the silicon off the casting. A sulphuric acid bath is also employed, but in time hydrochloric acid will disintegrate iron. Mr. Outerbridge offered a written discussion, describing the action of the weak acids in the bilge water from the hold of freight steamer in producing an effect on a cast iron strainer similar to that described by Mr. Lane, and cited another case where oil refiners' acids had so changed the character of a cast iron pipe that picks penetrated it without difficulty.

Prof. Stoughton said that Mr. Lane's theory was interesting, whether correct or not. It would hold, in his opinion, for graphitic carbon, but not for the other elements because they are in a combined state. Graphitic carbon does occupy space and therefore is of interest. He told of the theory advanced by Sir William Austen dealing with the molecular volume of impurities and stated that this bore many points of resemblance to that offered by Mr. Lane. The former was put forth many years ago. Prof. Stoughton also took issue with the author of the paper over the statement made in its presentation that the microscope was of little value to the foundryman. It has already helped the foundryman greatly, he declared, and can be of as much or even more assistance in the foundry as in steel works, all of which, provided they are of any considerable size, are now equipped with a complete microscopic department. The problem of the iron foundryman is much more complex than that of the steel founder and therefore the microscope can properly be applied and will prove of much importance. He cited the case of a concern operating a number of gray iron foundries having taken up within a year the microscopic study of cast iron. Prof. Stoughton stated that at the afternoon session he hoped to be able to present a number of lantern slides in proof of his contention. Another speaker, in closing the discussion for the morning, said that Mr. Lane had given a few facts, but that the further value of his paper was entirely negatived by his failure to take into consideration the fact of the elements combining.

Afternoon Session.

In refutation of the statement made at the morning session by Mr. Lane that the microscope is of little value in the foundry, Prof. Bradley Stoughton supported his contention that the contrary is true with a large number of lantern slide illustrations of micrographs of different grades of iron and steel.

"The Foundry Cupola and Iron Mixtures."

A written discussion on this paper, prepared by W. J. Keep, Detroit, was submitted by George R. Brandon. He favored blocks for cupola linings because they last longer than the same quality of square arched bricks and have fewer joints. He considered the defined bosh and enlarged melting zone as of doubtful benefit. Tuyeres may be located so that any quantity of iron may be accumulated in the cupola before tapping. The lower the tuyeres the smaller the amount of fuel required on the bed and the greater the economy. For cupolas 84 inches and larger, he claimed the mechanical charging machine greatly reduces the cost of operation. He also doubted the correctness of the statement that a fuel ratio of 18 to 1 had been attained in actual operations. From a record covering 11 months' operation in which over 13,000 tons were melted, the ratio of iron to fuel was 10.31 to 1. These were considered excellent results.

Foundry Blower Practice.

A discussion of a paper on "Foundry Blower Practice," by W. B. Snow, of Boston, including curves and tables to calculate the horsepower of fans was submitted by H. de B. Parsons. He believed this would be of value as the catalogs issued by manufacturers do not in general give this data conveniently for the use of engineers. Dr. S. A. Moss doubted the absolute accuracy of the tables, but conceded the correctness of the author's formula for pressure up to two ounces per square inch. For greater pressures, he declared a correction must be made to allow for the change of density of the fluid during expansion.

J. R. Fortune and Harold S. Wells submitted written discussion of a record of cupola tests made by the engineering department of the Murphy Iron Works, Detroit. Requiring increased cupola capacity, and not desiring to install additional furnaces, experiments were made by substituting a positive pressure blower of greater capacity for a fan blower, and the melting rate was increased from 8½ to 9.45 tons per hour. To secure the proper amount of air with a minimum blast pressure the tuyere openings were enlarged and the depth of the bed increased. As a result of increasing the tuyere openings and decreasing the coke bed the melting rate was increased to 11 tons per hour. The fact that an excess of coke decreases the melting ratio is explained by the fact that the iron in the cupola is melted in a fixed zone. The first charge of iron above the bed being melted by burning the coke in the bed, as this iron is melted the charge of coke above it descends and restores to the bed the amount which has been burned away. If there is too much coke in the charge the iron is held above

the melting zone, and the excess coke must be burned away before it can be melted, and this reduces the economy and the rate of melting.

Patterns For Repetition Work.

Commenting on this paper which was prepared by Edgar H. Berry, New York, E. H. Mumford referred to some difficult castings which the author made on molding machines successfully. Although not generally realized, he stated that it is not always the machined pattern, having a smooth surface that is the best for successful molding. A pattern should not have a better finished surface than the casting to be made from it should have, and it will then be more accurate.

Some Limitations of Molding Machines.

This paper, presented in abstract by the author, E. H. Mumford, was discussed by E. N. Berry, who directed attention to points in his paper on "Patterns for Repetition Work," and Mr. Mumford's that agreed. E. Ronceray, Paris, briefly described the universal system of machine molding invented by him and explained features of some new machines more recently invented.

CONVERTER VS. SMALL OPEN HEARTH—III

Requirements of the Side Blown Vessel—Basic and Acid Open-Hearth Processes

BY W. M. CARR

IN preceding chapters we considered the advantages and disadvantages of the converter process and brief mention was made of crucible practice. Before elaborating on the open-hearth, the essentials of the three in making steel castings for general purposes will be given. In the crucible process we have merely a melting method. The charge may be wrought iron, mild-steel clippings or punchings mixed with a little pig iron, charcoal and manganese oxide. The mixture is charged into a graphite pot holding about 80 pounds. The pot and charge may be put into an ordinary pit furnace with anthracite coal or coke as fuel. Oil may be used, or producer gas when the Siemens regenerative style of furnace will be necessary. After heating for about three hours the whole charge will become liquid enough to cast. During this melting the carbon will have slightly increased because of absorption from the walls of the pot. The sulphur and phosphorus will not be less than the percentage of the original charge. To keep the product within defined limits, the raw material must be carefully selected as the charge will only become steel by melting a mixture first compounded to produce it.

Converter Requirements.

The converter process requires special or "fancy" grades of pig iron. It must be high in silicon and very low in sulphur and phosphorus. Steel scrap may be mixed with it, but it in turn must also be of low sulphur and phosphorus content. The two latter elements are not removed in bessemerizing or converting. The pig iron necessary is costly in comparison to open-hearth stock and is also less available in the market.

A mixture of pig iron and scrap of the character just mentioned is melted in a cupola at a high fuel ratio. A portion of it is tapped out and transferred to a converter of special design holding about two tons of metal. Jets of air under pressure are then impinged upon the surface of the bath passing through openings or tuyeres placed a short distance above and at the same level of the metal. By slightly tilting the converter, the angle of the tuyeres is changed in relation to the surface of the metal. It is important that the pig iron is high in silicon as the burning or oxidization of this element by the air blast is depended upon to elevate the temperature of the charge sufficiently high to permit the carbon to be burned out also. The only elements removed by the actions going on within the converter are the manganese, silicon and carbon in the order named. The end of the operation is indicated by the size and color of the flame produced by the burning of the carbon. The chemical actions mentioned all have a tendency to greatly elevate the temperature of the treated metal. The blast is shut off when in the judgment of the operator the blowing has gone far enough. The usual ferro-alloys are then employed and the product poured into molds. The distinct feature of the successful handling of a converter depends upon the appearances of flame effects issuing from its mouth during the blowing period near the end of the operation.

Open-Hearth Practice.

In open-hearth practice we have a furnace built of refractory brick with a long, narrow and shallow bath, the several dimensions varying with the capacity of the furnace. The hearth may be lined with silica sand or magnesite. The charge will be a mixture of pig iron and steel scrap. The fuel may be natural gas, producer gas or fuel oil. By means of reversing valves the flame from the combustion of one of the fuels mentioned is made to travel at intervals from one end of the furnace and then the other. During the passage of the flame across the hearth the charge gradually melts and eventually becomes liquid. Under proper thermal conditions induced by a regenerative system built below the furnace body, and by slag formations, the composition of the bath undergoes chemical reactions. In acid practice the elements effected are silicon, manganese and carbon only. In basic melting the sulphur and phosphorus are removed as well as the first named elements.

Acid and Basic Processes.

Open-hearth methods may be conducted in basic or acid hearths, but

the relative values of either method will not involve the size of the unit. Acid melting, like the converter, requires special pig iron and scrap, although the pig iron need not be as high in silicon, but is subject to limits in regard to sulphur and phosphorus.

Basic melting has a wider scope in the choice of stock but is limited principally as to silicon. The ores from which acid pig iron is made are daily becoming scarcer while ores suitable for the smelting of basic pig iron are plentiful. The ore situation is gradually and permanently making the basic process a fixture and therefore in considering steel casting problems the basic process must be taken into consideration.

Refining Efficiency.

As a melting unit the open-hearth furnace is very slow, but as a refining unit it cannot be surpassed and these advantages make it preferable to any other steel making process in this respect. At any time after the charge of stock has become melted it is possible to take samples from the bath and by means of chemical tests determine the extent of changes in composition that have taken place. If the changes in composition are not those sought, corrections can be made through different reagents added to the bath. The carbon may be raised by the use of spiegeleisen or pig iron. If the carbon is not low enough its removal may be accelerated by adding iron ore. The bath of metal can be tapped out of the furnace at any time according to the judgment of the melter who has perfect control of the temperature and composition by the means described or by the use of ferro-alloys in the ladle.

Therefore, in the operation of an open-hearth furnace the conditions of the bath are subject to inspection at any time, and by chemical tests of samples or by fracture indications of test pieces, the personal equation is reduced to the minimum.

In crucible melting, if an error occurs in the mixture or charge the same error is carried through all of the operations. Tests cannot be made during the melting to ascertain the exact composition. The results reflect the operator's skill.

In converter methods it is not practical to make corrections in the cupola after charging, nor is it practical to stop the blowing operation in the converter to sample the bath and make chemical tests and forestall possible errors.

Continuous Operations.

An open-hearth furnace has the advantage of protracted runs before being taken off for repairs. With ordinary care it will last for months. It can be built in any capacity from two tons per heat to 25 tons, but for the purpose of comparison in this discussion the open-hearth will be confined to the five-ton size. Such a size is convenient for small tonnages with some degree of irregularity in output. The smaller the unit the less the total cost for repairs, but the cost of repairs per ton will be higher than in the larger sizes, but the cost of installation will be greater than the smaller.

A small unit has the advantage over a larger one in that it can be operated with greater irregularity, as the roof span is so much less; there will be less strain on the brick work because of expansion and contraction following the heating up and cooling down. Therefore it is important in the larger sizes to keep the furnace hot continuously during short intervals of idleness with a view of avoiding rapid changes in brick movements and obviating the danger of collapse. In such instances the fuel consumption will be heavy but in the smaller sizes the cost of maintaining the heat in the furnace, say over night, will not be so expensive.

In the event of general repairs the outlay for labor and material to put a small furnace back into commission can be effected at a much lower cost and in much less time than in the larger sizes. In that respect the five-ton furnace appeals to moderate capital investments.

A five-ton furnace is capable of turning out two heats in an ordinary working day with no more labor than would be required with a single two-ton converter and with cheaper melting stock for the open-hearth, the cost of production will not be heavier even with extra fuel to keep the furnace hot over night. This particular point will require accurate data to support this statement, which will be given in one of the following articles.

BIRMINGHAM BRANCH OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

A meeting of the Birmingham branch of the British Foundrymen's Association was held at the city technical school, Birmingham, on Saturday, Nov. 23. There was a large attendance including several members of the Society of Mechanical Engineers. A lecture was delivered by Prof. Turner, of the Birmingham University, on "The Crystallization of Cast Iron." The lecturer pointed out that metals generally show a marked tendency to crystallize when solidifying or when heated nearly to their point of fusion.

F. J. Cook pointed out the great interest of the lecture to foundrymen, as it explained why the molder sometimes "bared" the metal from corner to corner. The object sought is to prevent cracking, but the molder does not always understand the scientific reason for his own action.

R. Mason said that the lecturer had once more suggested to his mind the old question of shrink holes in castings. That subject would crop up whenever foundrymen meet. It puzzled them so much that they sometimes thought they would like to be inside the castings box to see what was happening. He had never seen a finer lot of photographs than some of those shown. The molder now could well understand the connection between crystals and the lines of weakness. He had known good results from putting a piece of cold iron in the mold, allowing the molten metal to cool round it, as it caused it to solidify more quickly.

Mr. Poole said he had picked up several wrinkles from the lecture. In one case he had had a casting with a depression in it three-eighths of an inch deep and two inches long, yet, when he broke it the texture was perfect in every way. He had an impression this was due to the action of minute particles of the kind described. He experienced great difficulty in getting solid castings of certain spindles four inches in diameter and two feet long.

Mr. Saddler stated that he had a blow hole in the thick part of a housing big enough to take in his fist, but instead of being an ordinary blow hole it was filled with strings of metal almost like icicles.

Prof. Turner replying said it seemed to him important not to keep the metal too hard or too soft, and not to get in too much graphite. The quicker it was cooled the more chance they had of getting it solid. It might be possible to keep the metal liquid, and let it cool slowly. But that was rather tedious, and the best way was to cool all round quickly.

STEEL CASTINGS BY McHAFFIE PROCESS

Methods Pursued in the New Plant of the Chester Steel Casting Co., Chester, Pa.—Crucible Steel Foundry

WITH SIX large steel casting plants having a tremendous combined annual output located within its confines, the city of Chester, Pa., has for many years maintained its lead over other sections of the east in the steel casting industry. Early in August this year another steel foundry was placed in operation in this important center, which, unlike its neighbors, employs the crucible and McHaffie steel processes exclusively. The Keystone Steel Casting Co., incorporated on April 11, 1907, was conceived and organized by men of wide practical experience who had served as heads of departments in other steel casting works, and their combined knowledge was utilized in planning and equipping this plant.

The foundry has been built on a tract of six acres on the main line of the Philadelphia, Baltimore & Washington railroad near Lamokin station and the buildings have been so arranged that the plant may be developed to meet the requirements of increased demands without destroying the present layout.

The building which contains the McHaffie department is 160 x 50 feet, one end of which opens into and is used as a part of the crucible foundry. All of the buildings have been substantially constructed, special care having been taken to insure ample lighting and ventilating facilities.

McHaffie Process.

With the exception of the mixture and the subsequent annealing, the McHaffie process is similar to ordinary gray iron practice. The iron is melted in the cupola and is poured into green or dry sand molds. The castings, however, are subsequently annealed, which converts them into a semi-steel. The success of this process depends largely on the careful selection, proper mixing and melting of special grades of imported white and mottled pig iron. A view of the McHaffie foundry, including the cupola which is lined up to 54 inches inside, is shown in Fig. 1.

Annealing Ovens.

The annealing ovens, four in number, located in a separate building, are shown in Fig. 4. After the castings have been shaken out they are conveyed to the annealing building, where they are carefuly packed in chemically treated roll scale before they are charged into the furnace. The furnaces are 12 feet square, and the inside chamber of each is lined with metal pans made of a mixture similar to that used in the McHaffie castings. For very light castings, iron charging boxes are used to prevent the pieces from being lost in the roll scale, some of which is thrown out as waste after each anneal, while a certain proportion is used again with new scale. The temperature required for converting the castings into semi-steel ranges from 1,200 to 1,400 degrees Fahr.

The building containing the furnaces is 60 x 80 feet and adjoin-

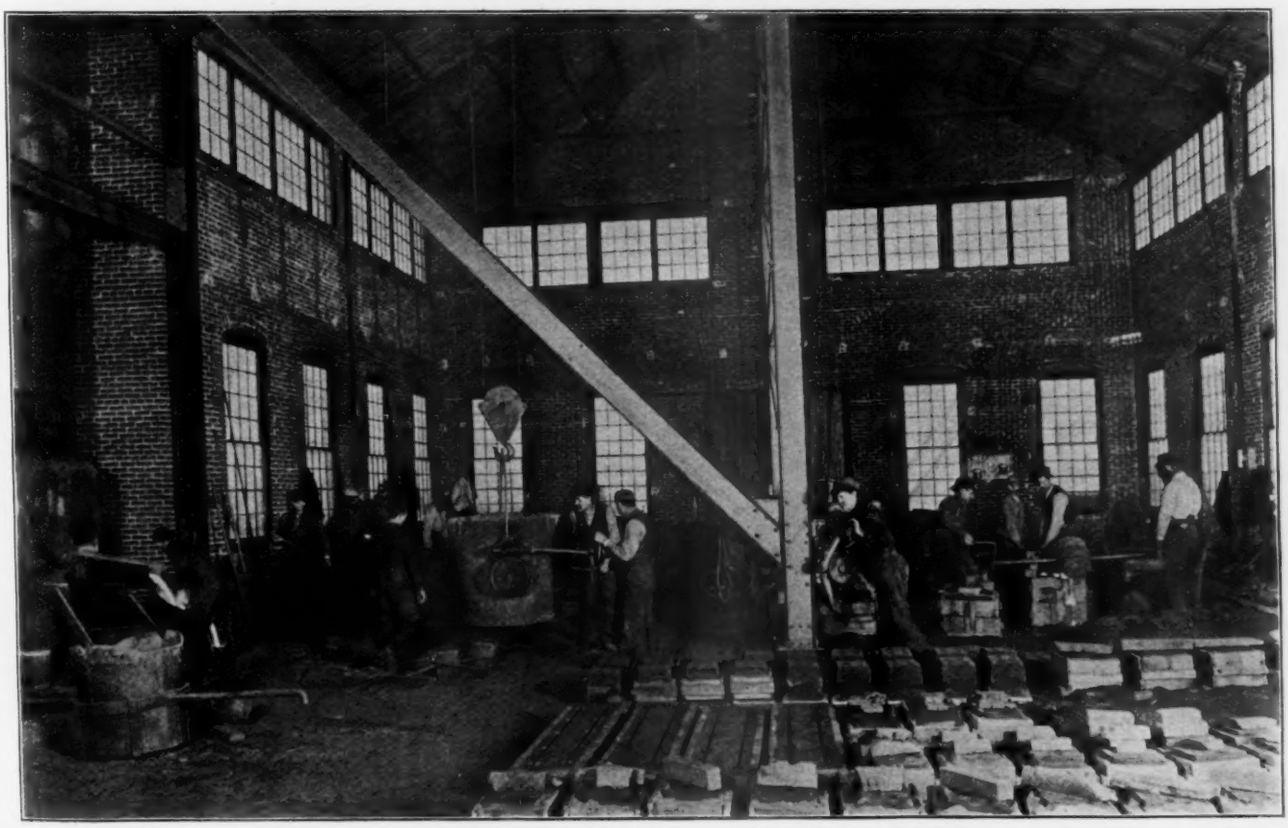


FIG. 1—INTERIOR OF McHAFFIE FOUNDRY

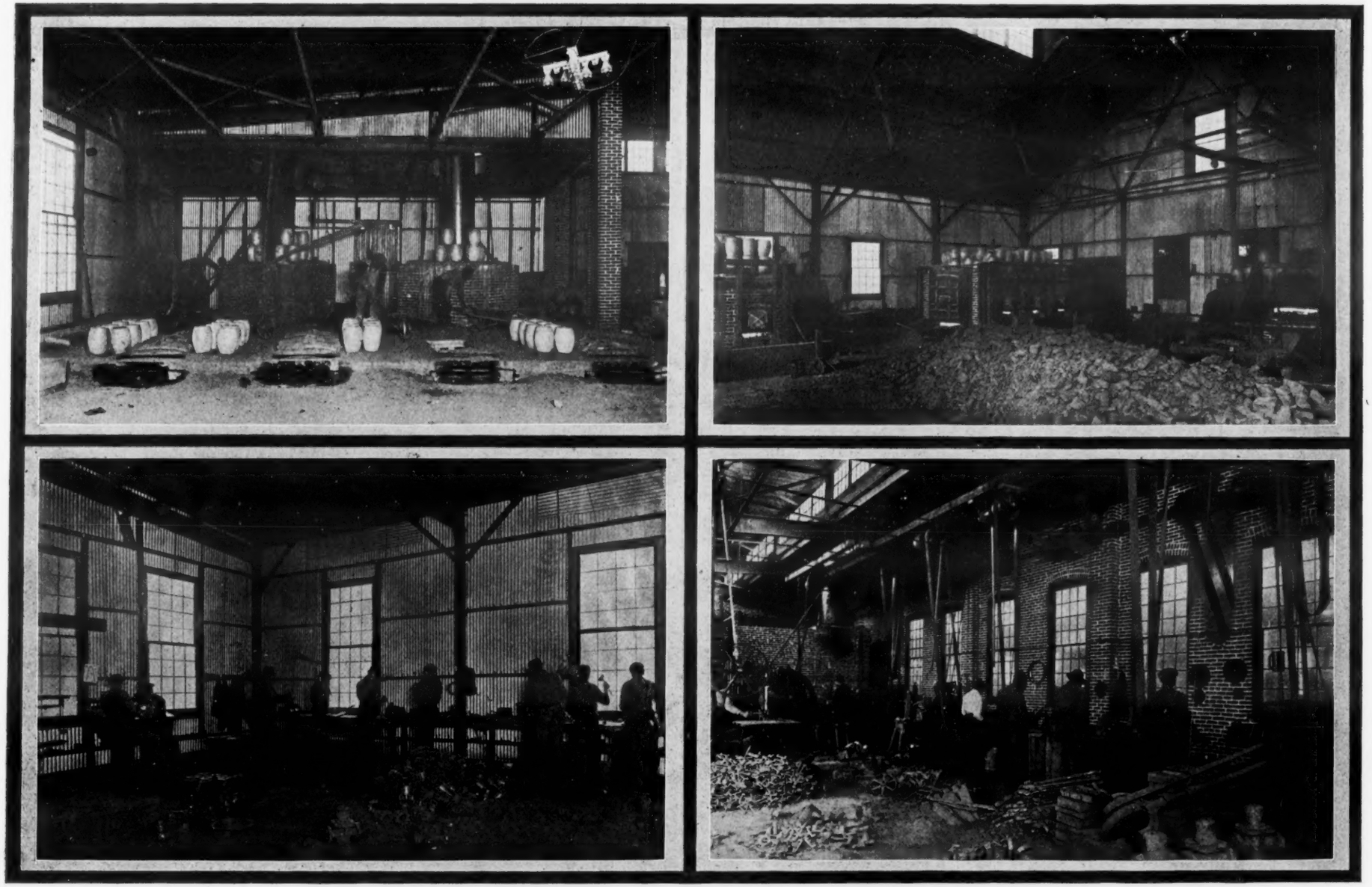


FIG. 2—CRUCIBLE STEEL MELTING FURNACES
FIG. 3—FINISHING DEPARTMENT—CHIPPING

FIG. 4—ANNEALING FURNACES, MCHAFFIE DEPARTMENT
FIG. 5—FINISHING DEPARTMENT, GRINDING AND FINISHING CASTINGS

ing it is a room containing the roll scale, 40 x 32 feet, which contains a storage bin for the scale and a department for treating the scale before it is used.

What is generally known as McHaffie steel is a high grade semi-steel having a tensile strength of 45,000 to 50,000 pounds per square inch, the metal being uniformly sound, homogeneous, strong and tough, and yet sufficiently soft to machine readily. To facilitate the handling of the bull ladles, the McHaffie department is equipped with a 15-ton jib crane.

Crucible Steel Department.

In its crucible steel department, Fig. 2, this concern is operating two batteries of melting furnaces, each consisting of two furnaces having a melting capacity of eight pots each to the heat, giving a combined maximum melting capacity of 3,200 pounds per heat for the four furnaces. The furnaces are fired wi h fuel oil, the Maddox improved pan system being used. Owing to the use of fuel oil, special melting pots have been provided by the Jos. Dixon Crucible Co., Jersey City, N. J., which are made of materials adapted to withstand the intense heat to which they are subjected. With proper care they will average from two to three heats, although some have shown even a greater life.

The oil for the furnaces is stored in two tanks of 6,000 gallons capacity each. In the crucible process the highest grades of melting material are used, consisting chiefly of steel punchings, about 100 pounds being charged into each pot. Owing to the use of fuel oil, it is possible to take off the first heat about three hours after charging, the next heat about 1¼ hours thereafter, and additional heats following every hour. A view of the crucible department is shown in Fig. 6.

Cleaning Equipment.

The small castings which are not sand blasted are cleaned in a tumbling mill. This room is 16 x 20 feet and contains a rumbler 40 inches in diameter. The mill is electrically driven and sufficient room has been provided for the installation of additional mills. The finishing department, 80 x 32 feet, shown in Fig. 5, contains all the necessary machinery for cutting gates and risers from the castings and for finishing them before shipment. The cleaning equipment includes two band saw cutting machines, one cold saw cutting machine, planer, shaper, double emery wheel grinders, saw sharpeners, and other necessary tools.

Miscellaneous Departments.

The sand blast room is 20 x 16 feet, air being furnished by a compressor located in the engine room. The cupola house opening into the McHaffie department is 16 x 32 feet and is provided with an elevator for hoisting the melting stock to the charging floor. A commodious pattern shop 25 x 40 feet, has also been provided, equipped with a 36-inch band saw, 16-inch jointer, lathe and other tools, all of the machinery being electrically driven. The power house is 32 feet square and contains in addition to the boiler and engine an air compressor and a blower direct connected to a vertical engine for supplying blast to the cupola. A portion of this room is used for a repair department and contains a lathe, drill press and other tools necessary for making general repairs throughout the plant.

Various grades of crucible steel castings are made by this company to meet the requirements of the trade and by using special melting material in its standard mixture it provides a grade of castings preferred for automobile work which have a tensile strength of 70,000 pounds per square inch. This concern makes a specialty

FIG. 6—INTERIOR OF CRUCIBLE FOUNDRY

FIG. 3—FINISHING DEPARTMENT—CHIPPING

of gears, and gear and worm blanks of either crucible or McHaffie steel.

The various departments of the plant are so located that there is a minimum amount of handling of the castings through the various stages of manufacture from the raw material to the finished product. Although operations were commenced only last August, the output has already exceeded the limit estimated for a plant of this size in this period, and the orders now on the books of the company are heavy, notwithstanding the business depression.

MACHINE CORES FOR FOUNDRY USE*

BY GEORGE H. WADSWORTH

A COMMON fallacy among foundrymen is that one core mixture will suit a wide range of foundry conditions. The facts are that in a foundry it may be profitable to have a number of separate and distinct core mixtures, using entirely different grades of core sand and binders. From this it is clear that each class of cores must receive separate consideration, and this must cover the core room, the foundry and the finishing departments.

It is necessary on the one hand to take account of what we have to deal with, and on the other, what the results are which we hope to achieve. The term core, as it is used by foundrymen, has been defined as a body of sand projecting into an opening left in the mold to form a hollow in the casting. Later, however, the term has come to have a broader significance, and the portion of it which we have to deal with covers only such cores as are made by the core maker and delivered to the molder for insertion in the mold.

In accordance with this we may define a core as any body of sand which is made and baked and then introduced into a mold, either to form a hollow in the casting or to form one face in the mold, as in the case of covering cores.

Properties of Cores.

A core must be porous so as to provide a ready passage for the gases as they escape when the metal is being poured about the core. At the same time it must have sufficient strength to resist the wash of the metal. The composition of the core must be such that it will burn brittle when exposed to the metal, so as to crush as the metal shrinks about it, thus relieving the casting from unnecessary strains. This is especially true in the case of cores used for brass and aluminum castings. The core must also burn brittle enough so that it will clean from the casting easily, and in some cases it is important that the surface be of such a nature that it will give a perfectly true, clean, parallel hole free from rough scale.

Undesirable Mixtures.

One great objection to many core mixtures is that they contain material which, when exposed to the heat of the metal, gives off gases which are injurious, or if not, at least troublesome to the molders; and no matter what advantage binders of this kind may possess, the foundryman will always try to supplant a binder giving trouble from gas by one giving a practically odorless gas.

Another point which must be considered is that the core mixtures must be cheap; but a cheap core mixture may mean a dear casting, and, as stated above, not only the core room, but the foundry, cleaning room and machining departments should be taken into consideration when selecting core room materials.

In all core mixtures which come under the scope of this paper, sharp sand forms the principal portion of the body of the core; the remainder of the material being known as the bond. Water in a core mixture plays the part of an agent for rendering the bond active previous to the baking of the core.

Bonds For Cores.

Bonds may be divided into two classes, natural and artificial. The natural bonds practically all belong to the clay class, that is, they are some alumina product. Sand frequently contains a certain amount of alumina or clay, which is frequently known as loam. For some classes of work this forms an efficient core bond, but in the case of brass, aluminum, or gray iron, it often burns so hard during casting that it is very difficult to remove the core when the clay is present in large quantities. Machine made cores fill the gap between the exceedingly small and delicate and very large cores. Large cores are rarely required in such quantities as to warrant the use of a machine in their production, while small cores, and particularly those which are of irregular shape, require special treatment, and when required in quantities must be made in metal boxes frequently provided with carefully fitted core wires.

A word in regard to such cores may be of interest. Where these cores have to stand up against quite a body of metal, it is often necessary that they are made exceedingly stiff. This necessitates the use of core wire. The ordinary annealed iron wire is too soft for this purpose. Some foundries have overcome this difficulty by stretching the wire about 20 per cent of its length, which hardens and stiffens it. The same result may be attained by having the entire wire annealed. Such wire as this is being manufactured by one firm in this country.

The mixture for small cores should be made of good sharp silica sand and some good strong core binder. The expense per pound of mixture is a consideration which drops out of sight entirely in comparison with the necessity for having strong, accurate ores which can be handled and will not fail when the metal strikes them.

Machine Made Cores.

We will now consider the class of cores known as machine made cores.

The first machine that we developed was one to produce cylindrical cores from 1 to 1½ inches in diameter. Dies were afterward fitted to this same machine, which enabled it to make cores to 2¼ inches in diameter down to ⅜ inches. At first it was supposed that only cylindrical cores could be made, on account of the fact that it was observed that the core as it came from the die always rotated. Later, however, an attempt was made to produce square cores, and as this proved successful many other irregular shapes of prismatic cross section have been made.

*Presented at the December meeting of the Chicago Foundry Foremen's Association.

It was natural that some foundries would demand larger cores than the first machine could produce, and a new one was designed known as our No. 2 machine, which had a capacity for cores up to 5 inches in diameter. This was successful, and the design was later changed to produce cores up to 7 inches in diameter.

When the first machine was introduced it was intended to be operated by hand, but in response to the demand which came from certain customers, power attachments were supplied. When the large machine was designed it was intended as a power machine only, but experiments showed that by using a large fly wheel it was possible to make any size core by hand, and later there came an inquiry for a machine capable of turning out slab cores, and to meet this demand the multiple spindle slab core machine was designed.

Multiple Spindle Machine.

The next step was naturally to use the multiple spindles for turning out several cores in parallel. The next inquiry received was one that at first staggered us. It was for a machine to make small square cores which should not vary more than 2/1000 of an inch above or below the required size; in other words should be held within 4/1000 of an inch as the total limit of error. To accomplish this the multiple spindle principle was applied, special dies being designed.

Core mixtures form an important part of the core machine business. They vary greatly, depending upon the size of the core used and the available material. As in all core mixtures, sharp sand is the basis. Flour has also been found to be a good binder for most core sands, but it has also been found advantageous to add a small quantity of boiled linseed oil to the mixture.

For very small cores, a relatively larger amount of oil and flour is required, and the amount of water will cause the sand to pack in the dies and block the machine. The larger the die the smaller the amount of binding material necessary, and the larger quantity of water the mixture can carry.

Standard Mixtures.

Certain standard mixtures have been developed and recommended as a basis for experiment, but as the core sand used in each district is liable to vary from that used in other districts, the natural bond in the sand will have a varying effect, and hence the amount of bond to be added is dependent upon local conditions. The following mixtures are recommended:

Mixture for gray iron, cores ⅜ to 2⅛ inches—12 quarts silica, lake or clear sharp sand, free from loam or clay; 2 quarts flour, ½ pint boiled linseed oil.

For cores 2¼ to 7 inches—15 quarts sharp sand, 3 quarts of Zanesville or a loam sand, 3 pints flour, ½ pint boiled linseed oil.

Mixture for brass and aluminum castings—4 quarts silica or good sharp sand, 2 quarts brass molding sand, ¼ pint boiled linseed oil.

The more water the mixture will carry the harder and stronger the core will be when baked.

No. 1 core mixture for steel castings ½ to 2¼ inches—6 quarts silica sand, 1 quart flour, ¼ pint boiled linseed oil. This mixture is used without grinding.

Cores 2½ inches and larger—18 quarts silica sand, 3 quarts fire clay, 1¼ quarts flour, ½ pint boiled linseed oil.

These steel mixtures must be very thoroughly mixed by hand when a more suitable way is not obtainable.

The fire clay can be increased or decreased according to the hardness of the core with the sand being used.

No. 2 mixture for steel castings ½ to 2¼ inches—6 quarts silica sand, ¼ pint boiled linseed oil, 1½ pints flour. This is ground together thoroughly in a mill.

2½ inches and larger—6 quarts silica sand, 3 pints flour, ¼ pint boiled linseed oil.

We know that in practice many foundries have departed a long way from these mixtures, but believe that the formulas given above will serve as a guide in working out core machine mixtures.

In some cases all cored holes are bored in the machine shop. Under these circumstances, a perfectly smooth hole is not necessary. It is only essential that the core leave the casting readily, and that it does not leave a hard scale in the hole. This may usually be accomplished, by the use of a good grade of sand and a moderate amount of flour and oil in the binder.

It is of interest to note that with the advent of the core machine many agricultural implement manufacturers have discovered that machine made cores can produce true, round, parallel holes which will vary less than 1/100 of an inch in diameter, and that by the use of suitable blacking on the cores these holes can be cleaned perfectly, so that shafts may be safely run in bearings which are cored to receive them and are given no subsequent machining. In a like manner wheels are run on axles without machine work. In fact, the machine made core has revolutionized the design of several agricultural implements and other castings in which machine made cores are used.

Experiments With Various Mixtures.

We have been carrying on a series of experiments with a large variety of core mixtures to determine what is best for use in our foundry and also in the foundries of many users of these core machines. Some of the materials experimented with have been interesting. Some years ago the black loam from a celery swamp was tried in core mixtures with sharp sand, and it was found that when this was dried and ground, tempered and put through a core machine, it produced a core which left the work readily and gave a remarkably clean hole. The vegetable mixture contained in it shrinks in the oven and gives ample vent to the core, and burns out in the casting causing the core to become very rotten. Great care must be taken in baking such cores as they will burn very easily. It is probable, however, that it would be difficult to obtain a sufficient supply of this material in most localities.

The subject of core mixtures will not be complete without a consideration of the baking of cores. In the baking of an ordinary core two processes take place. First, the water used as a temporary bond is expelled as vapor, and second, by the application of a higher heat the permanent bond is made effective. The natural or clay bonds are made effective by drying, for at the temperature of an ordinary core oven these bonds do not vitrify.

Such bonds as linseed oil, corn oil, resin, pitch, etc., become effective by first being made more fluid under the influence of heat so that they spread rapidly through the sand grains, and second, by being partially oxidized or changed chemically so that as the core cools, it hardens.

This is particularly true in the case of linseed oil or corn oil. Where flour is used as a binder the hardening process is essentially the same as the making of bread; in other words, through the action of the heat and the expulsion of the moisture, the gluten in the flour is made effective.

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Uniform Foundry Cost System

The uniform cost system for jobbing foundries recommended by the cost committee of the Jobbing Founders' Association embodies more valuable data on cost accounting for the foundry than has heretofore been compiled. It represents the work of nearly two years of painstaking study and careful investigation and covers the subject of cost keeping in the minutest detail. As the committee states in its report it is not necessary for the jobbing founder to adopt the entire system as outlined, but to adapt such portions of it to his own peculiar requirements as will enable him to estimate intelligently on new work and to ascertain accurately the cost of his product. The variety of work constantly offered the jobbing foundries makes it difficult to estimate with any degree of accuracy and it has been truthfully stated that a good guesser is much to be preferred to a bad estimator. The need of a uniform system of accounting in the jobbing shops has been generally recognized by the trade for many years and at practically every meeting of the American Foundrymen's Association the subject has been freely discussed, but owing to the wide divergence of opinion little headway was made. On the other hand the Jobbing Founders' Association was organized for the specific purpose of accomplishing the work which has now been completed and the report is indicative of the success of its efforts. It is not for the purpose of eliminating or curtailing competition that this system is recommended for adoption, but to insure to every foundryman a fair profit on his investment. It is evident that a spread of from two to five cents a pound on the same work reflects wild guessing on the part of some and poor estimating by others. Specialty founders, owing to the nature of their work, have a better opportunity of estimating costs than the jobbing foundryman, and the fact that it is more difficult in the case of the latter makes the need of a more accurate and comprehensive system proportionately greater. A store keeper in every foundry, regardless of its capacity, is an absolute necessity and all supplies should pass through his department that they may be charged to the jobs for which they are required. The shipping clerk, if his duties are not too arduous, can assume the dual role, and it will be found that a tremendous saving can be effected by the addition of such a department. In the average foundry the loss of nails, facings, soapstone, chaplets and other supplies reaches prodigious proportions and represents a large part of the profit that should be returned to the owner, but is lost owing to the lack of system and as the result of wanton waste.

Trade Outlook

Further reductions in foundry iron quotations have been recorded in all markets during the last 30 days, and the indications are that still lower prices would be named on an inquiry of fair proportions. Southern iron is now on the basis of $14 Birmingham for No. 2, which is only a few dollars above actual cost of production, while the operators in the Youngstown and Sharon districts are asking $17.50. In the east $18 is quoted, but these asking prices are merely nominal in the absence of actual transactions. It can safely be estimated that not more than 50 per cent of the gray iron, malleable and steel producing capacity is operative, and the plants that are not closed are operating only four and five days a week. The let-up in the cancellation of specifications is the only bright feature in the general situation to record, and this may be indicative of a curtailment of consumption to actual requirements. Practically no new tonnage is being offered, and little is expected until there are more favorable financial developments. A slow resumption of the idle foundries is foreshadowed with the beginning of the new year, but a readjustment of prices on all raw and finished materials must be made before a reaction can occur. While new construction work is practically at a standstill, nevertheless there are indications that point to early resumptions which will necessarily be followed by a reinstatement of at least a portion of canceled orders. Pig iron production has been reduced to the minimum and in none of the great centers are stocks being accumulated. While the railroads are buying sparingly, they are conservatively providing for future needs, and orders for fair tonnages have recently been placed with the steel mills. The prices of all of the non-ferrous metals have suffered a further decline, and 12-cent copper is anticipated in the not distant future. Brass and aluminum foundries are running light, although the demands of the automobile trade are heavier than anticipated under prevailing conditions.

FOUNDRY & PATTERN SHOP EQUIPMENT

French Molding Machine—Sand Grinding Mill—Motor Driven Blowers

THE MOLDING machine shown herewith, manufactured by Ph. Bonvillain and E. Ronceray, Paris, and sold exclusively in the United States by the E. H. Mumford Co., Philadelphia, has been designed for use particularly where large numbers of pieces are to be made from one pattern.

The B-4 machine is different from the other types in that the pattern is mounted on a movable table, which can be raised and lowered beneath the stationary stripping plate, so that, instead of raising the mold up from the pattern, the pattern is drawn downward out of the mold.

Figs 1, 2 and 3 show this machine in three stages of the operation: Fig. 1 with the pattern raised up into the stripping plate and ready for the placing of the flasks for filling in the sand; Fig. 2 indicates the pattern enclosed in the flasks with the sand filler shown on top in white to provide for the reserve amount of sand required to fill in as the ramming progresses. The gate has been set in the pattern in this view and the hydraulic ram is in position to begin compression; Fig. 3 shows the table on which the pattern is mounted lowered out of the flask and at its bottom position, which is the stage at the completion of the mold. Corresponding to these three views are the sketches in Figs. 4, 5 and 6, which explain the steps in the operation of the machine. The ramming of the sand is accompanied by a partial withdrawing of the pattern with the result that it is moving in the same direction as the sand during compression, which fact adds greatly to the uniform ramming of the mold and is one of the advantages made possible in this style of machine. In order to provide for this withdrawing action on the pattern as the mold is rammed, the pattern must be mounted on a plaster of Paris base, conformable in outline to the stripping plate and of a height at least as great as the distance through which the pattern is lowered or in other words as great as the elevation of the bottom of the pattern above the stripping plate when the pattern is at its highest point so that at the end of the partial withdrawing operation, the bottom of the pattern will be flush with the stripping plate. This brings the pattern finally into the normal location with reference to the mold and flasks. With this machine the function of the sand filler is very apparent.

The device for accomplishing this

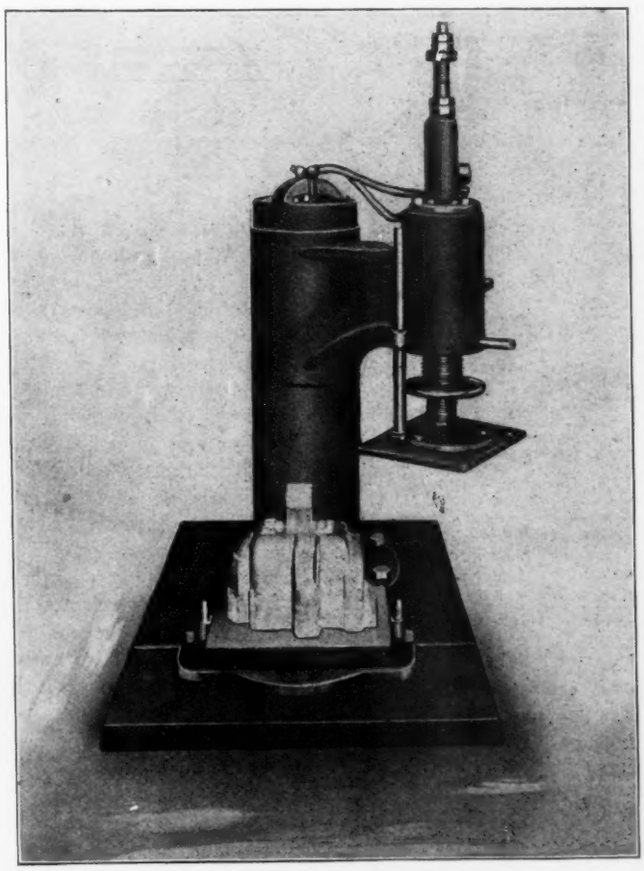


FIG. 1—PATTERN RAISED

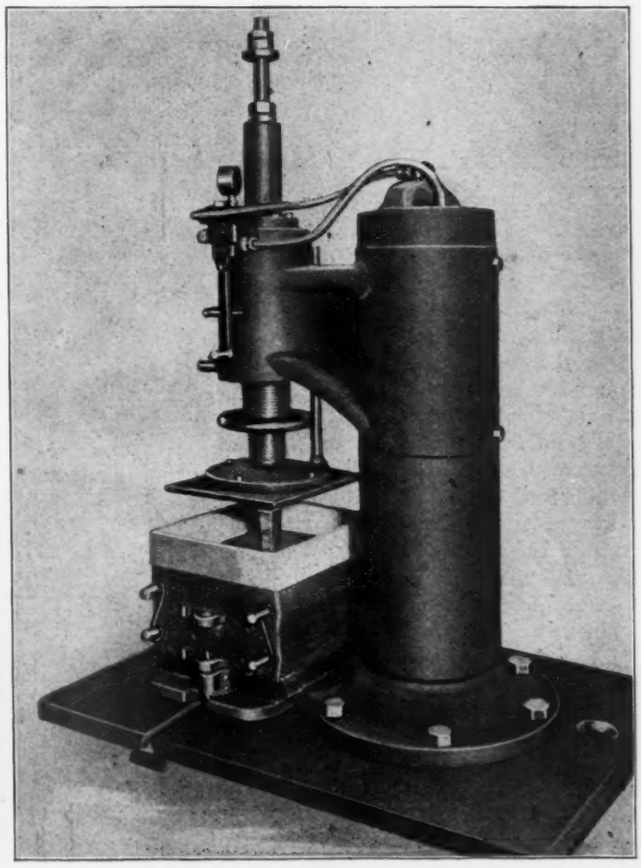


FIG. 2—PATTERN ENCLOSED IN THE FLASK

operation consists in having the sprue bear on a spiral spring in the pattern as shown in Figs. 4 and 5, and as the action of the ramming piston compresses the sand in the top of the mold it carries the gate downward also, which downward movement does not shove the pattern down, however, but is taken up in the compression of the spring. How far this action should proceed before the pattern should begin to move has been determined by experience and is governed by the extent to which the top layer of sand in the mold should be compressed and accordingly the gate is so shaped and fitted into the pattern as to shoulder up against it when the sand in the top

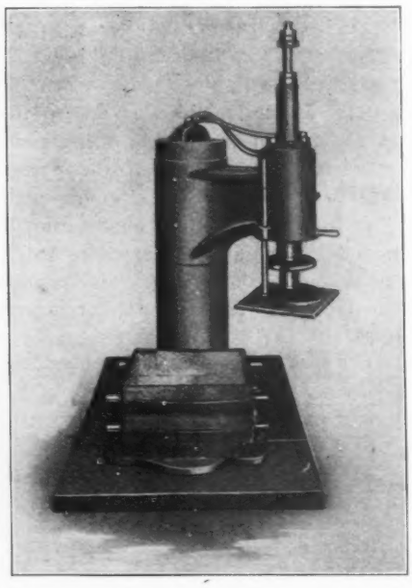


FIG. 3—PATTERN LOWERED OUT OF FLASK

of the mold is rammed to the proper density, and at that instant the pattern begins to move down with the ramming piston. It may be presumed that the top layer of sand acts as a ramming piston on the remainder of the mold and thus reduces the depth of sand to be rammed by that amount. The table on which these patterns rest is supported by a piston under pressure which holds the pattern firmly up in the mold and against the ramming piston. The "double ramming" action of the machines other than the B-4 type is a feature provided for those cases where the character of the pattern with reference to its intricacy and cores, make improbable or impossible the perfect ramming of the sand into those particular places, from the downward ramming action alone. It also avoids the necessity for using cores in many instances. Fig. 7 indicates one of the machines provided with this feature, and the method of operating by means of a foot pedal. This foot pedal acts through a cam

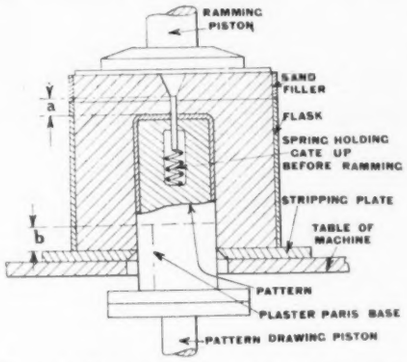


FIG. 4—B-4 MACHINE WHEN STARTING RAMMING

Distance b shows how Pattern is withdrawn while Ramming; Distance a shows the Movement of the Sprue before the Pattern Begins to Move.

and screw device on the piston which raises and lowers the table shown in this view and Figs. 8 and 9, beneath the pattern.

The ramming is done by stools dropped through the core holes of the pattern or so placed on the table as to be directly under the portion of the mold to be "double rammed." Around the circumference of the movable table posts are set to regulate the extent of the ramming action and as shown in Fig. 8 the distance the table moves up is determined by the contact of these posts with the stripping plate. This distance is predetermined and precautions are taken to have it absolutely uniform for all the stools as well. The plaster of Paris base of the pattern is sufficiently thick to serve as a guide for the stools and so when

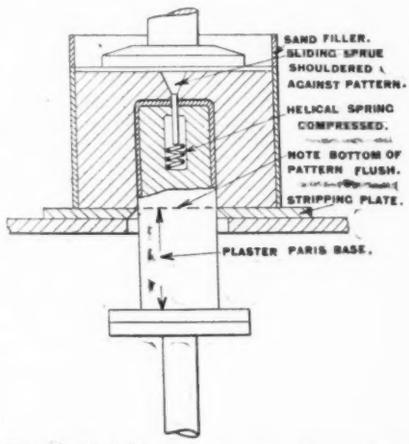


FIG. 5—B-4 MACHINE WHEN RAMMING IS COMPLETED

the table is raised these stools are forced up into the mold in the desired places, it ramming the sand to the desired density.

For double ramming in connection with other forms of intricate patterns a thin stripping plate is used. An example of such a pattern is the fan tooth gear shown in Fig. 10. Here the stripping plate, which is made thin enough to permit of its being forced through the sand, is supported by the stools which rest on the movable tables as in the other cases, and takes the place of the several stools. The stripping plate may be made very light because it can be supported in as many places as desired. This device makes possible a very accurate and well rammed formation of the teeth in the mold.

In these types of machines when

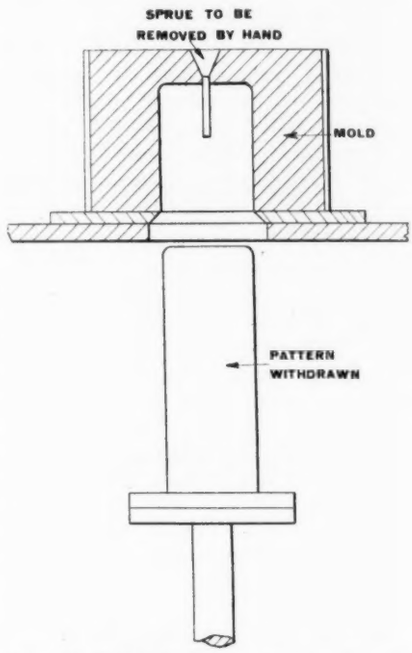


FIG. 6—B-4 MACHINE, SHOWING PATTERN WITHDRAWN

the mold is completed the pattern remains fixed on the table and the mold is drawn upward and off the pattern by the piston operating the table as shown in Fig. 9. This drawing action begins as soon as the posts come in contact with the stripping plate.

In Fig. 7, it will be noted that the sand filler above the flask is swung from a collar mounted on the pillar of the machine. This arrangement avoids the necessity of raising the ramming piston to clear the sand filler, since the sand filler can be swung on the pillar at the same time as the ramming piston. This feature applies as well to the B-4 machine.

The B-4 machine is just now being offered for such work as the molding of projectile shells, window counterweights and bathtub forms, where an unlimited duplication of parts obtains.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

STANDARD SPECIFICATIONS FOR GRAY IRON CASTINGS.*

Process of Manufacture.

1. Unless furnace iron is specified, all gray castings are understood to be made by the cupola process.

Chemical Properties.

2. The sulphur contents to be as follows:

Light castings	not over 0.08 per cent
Medium castings	" " 0.10 " "
Heavy castings	" " 0.12 " "

Classification.

3. In dividing castings into light, medium and heavy classes, the following standards have been adopted:

Castings having any section less than ½ inch thick shall be known as *light castings.*

Castings in which no section is less than 2 inches thick shall be known as *heavy castings.*

Medium castings are those not included in the above classification.

Physical Properties.

4. *Transverse Test.* The minimum breaking strength of the "Arbitration Bar" under transverse load shall not be under:

Light castings	2,500 pounds
Medium castings	2,900 "
Heavy castings	3,300 "

In no case shall the deflection be under 0.10 of an inch.

Tensile Test. Where specified, this shall not run less than:

Light castings	18,000 pounds per square inch
Medium castings	21,000 " " " "
Heavy castings	24,000 " " " "

"Arbitration Bar."

5. The quality of the iron going into castings under specification shall be determined by means of the "Arbitration Bar." This is a bar 1¼ inches in diameter and 15 inches long. It shall be prepared as stated further on and tested transversely. The tensile test is not recommended, but in case it is called for, the bar as shown in Fig. 1, and turned up from any of the broken pieces of the transverse test shall be used. The expense of the tensile test shall fall on the purchaser.

Number of Test Bars.

6. Two sets of two bars shall be cast from each heat, one set from the first and the other from the last iron going into the castings. Where the heat exceeds twenty tons, an additional set of two bars shall be cast for each twenty tons or fraction thereof above this amount. In case of a change of mixture during the heat, one set of two bars shall also be cast for every mixture other than the regular one. Each set of two bars is to go into a single mold. The bars shall not be rumbled or otherwise treated, being simply brushed off before testing.

*Adopted by the American Society for Testing Materials.

Method of Testing.

7. The transverse test shall be made on all the bars cast, with supports 12 inches apart, load applied at the middle, and the deflection at rupture noted. One bar of every two of each set made must fulfill the requirements to permit acceptance of the castings represented.

Mold for Test Bar.

8. The mold for the bars is shown in Fig. 2. The bottom of the bar is 1-16 of an inch smaller in diameter than the top, to allow for draft and for the strain of pouring. The pattern shall not be rapped before withdrawing. The flask is to be rammed up with green molding sand, a little damper than usual, well mixed and put through a No. 8 sieve, with a mixture of one to twelve bituminous facing. The mold shall be rammed evenly and fairly hard, thoroughly dried and not cast until it is cold. The test bar shall not be removed from the mold until cold enough to be handled.

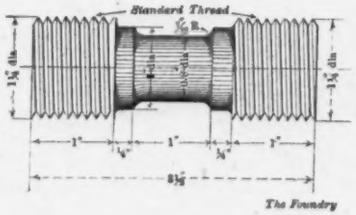


FIG. 1—ARBITRATION TEST BAR. TENSILE TEST PIECE

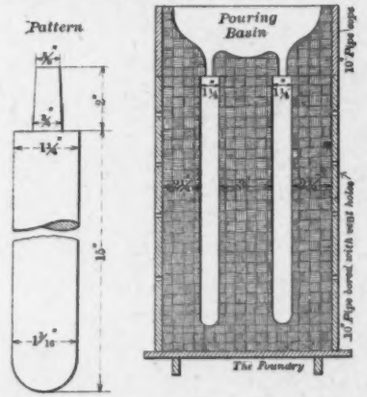


FIG. 2—MOLD FOR ARBITRATION TEST BAR

Speed of Testing.

9. The rate of application of the load shall be from 20 to 40 seconds for a deflection of 0.10 inch.

Samples for Analysis.

10. Borings from the broken pieces of the "Arbitration Bar" shall be used for the sulphur determinations. One determination for each mold made shall be required. In case of dispute, the standards of the American Foundrymen's Association shall be used for comparison.

Finish.

11. Castings shall be true to pattern, free from cracks, flaws and excessive shrinkage. In other respects they shall conform to whatever points may be specially agreed upon.

Inspection.

12. The inspector shall have reasonable facilities afforded him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall, as far as possible, be made at the place of manufacture prior to shipment.

TRADE NOTES.

At the recent annual meeting of the stockholders of the Independent Pneumatic Tool Co., Chicago, the existing board of directors and officers were re-elected for the ensuing year. The annual statement showed a very gratifying increase in the total volume of business as compared with the previous year. This concern has recently enlarged its plant at Aurora, Ill., and is installing a large amount of new machinery.

The Taylor Iron & Steel Co., High Bridge, N. J., is erecting a modern new machine shop 125 x 200 feet, and a foundry 60 x 400 feet. The principal product of the company is manganese steel by the Hadfield process in which the company has encountered a high degree of success. Howard E. White is president, T. F. Budlong, secretary, and Knox Taylor, general manager.

The Northern Engineering Works, Detroit, has installed a second Newten cupola in the plant of the Lombard Iron Works, Augusta, Ga.

The general offices of the Wile Power Gas Co., builder of producer gas plants, have been removed from the Cutler building, Rochester, N. Y., to 1688 Columbus road, Cleveland.

The Wetherill Finished Castings Co., Philadelphia, Pa., has removed its factory and office to Erie avenue, east of Richmond street.

Thomas W. Pangborn Co., New York, with factory and warehouse in Jersey City, manufacturers, dealers and agents in equipment and supplies for foundries, machine shops and pattern shops, having operated on a copartnership plan for several years, has been organized into a corporation. The same name is retained and the active management will be unchanged. The corporation begins business Jan. 1 with a capitalization of $60,000, of which $55,000 has already been paid in. The officers are; Thomas W. Pangborn, president and treasurer; Edward R. Cooledge, vice president; and John C. Pangborn, secretary. The directors include the above named officers, together with the following: John P. Beck, president, W. R. Ostrander & Co., New York; A. J. Powell, general manager Bradbury Piano Co., and secretary of the Webster Piano Co., Brooklyn; S. E. Martin, of Hoy, Martin & Burnet, attorneys, New York, and Frederick Schumann, retired, Brooklyn, N. Y. The growth of the business of this concern has been phenomenal. Originally launched along very modest lines, it has developed to such an extent that a large organization is now required for the handling of its many depart-

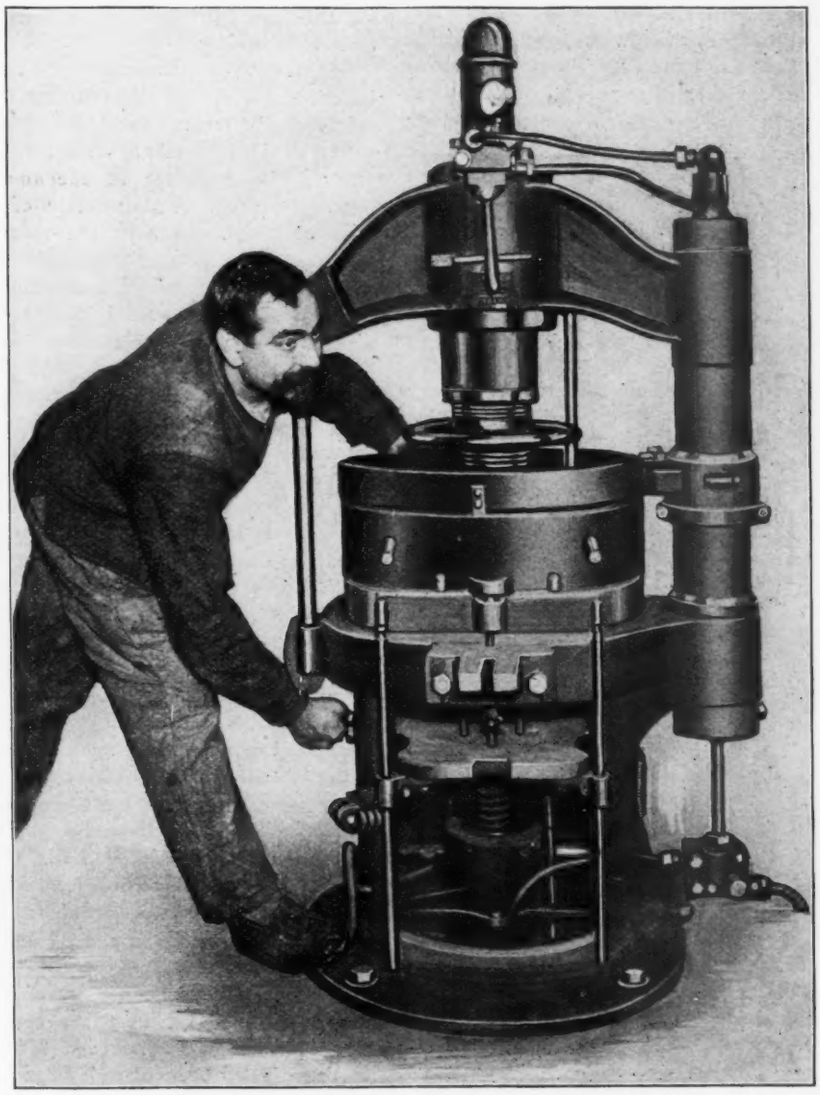


FIG. 7—DOUBLE RAMMING BY MEANS OF A FOOT-PEDAL

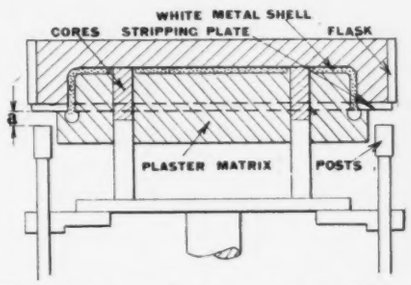


FIG. 8—BEFORE RAMMING FROM UNDERNEATH

Distance "a" = Amount of Double Ramming Judged to be Necessary.

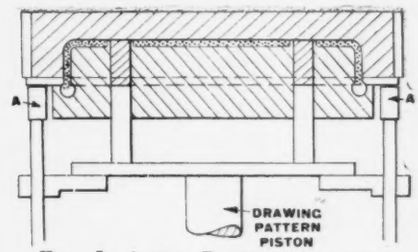


FIG. 9—AFTER DOUBLE RAMMING

Note stools and posts "A" resting against stripping plate.

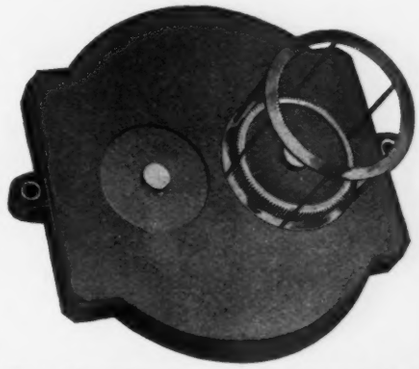


FIG. 10—STRIPPING PLATE PATTERN FOR DOUBLE RAMMING

ments. Upon the completion of the West Street building last May its offices were removed to that New York center of the machinery and foundry trade and a handsome suite on the fifteenth floor is now occupied.

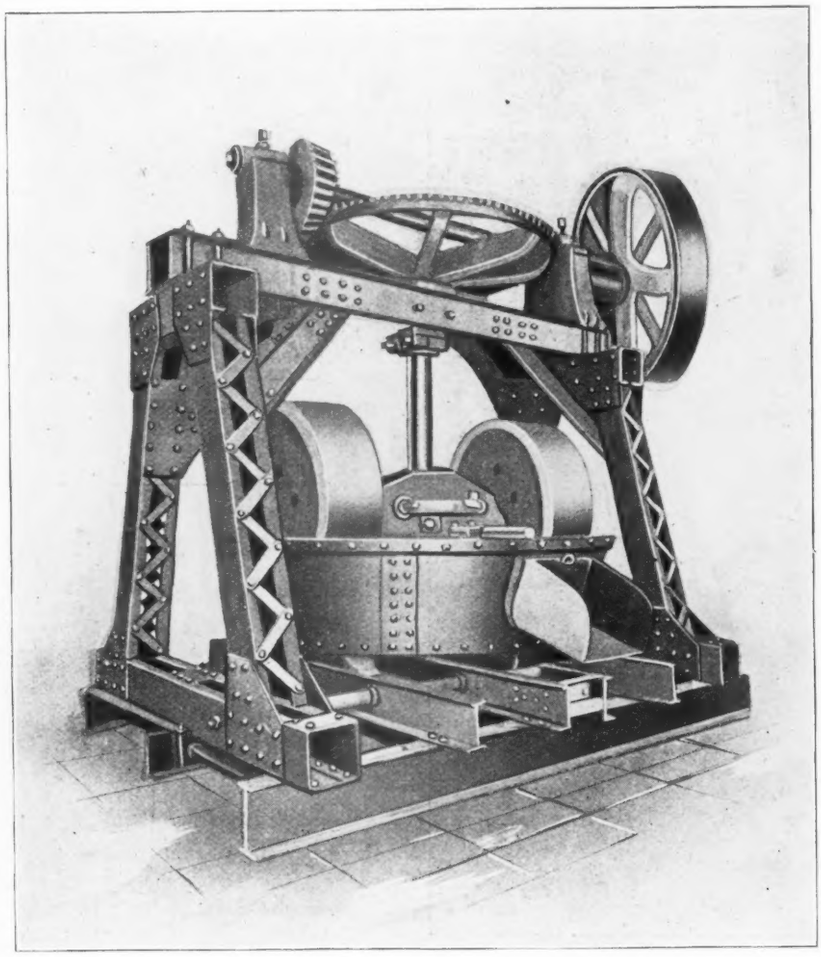
The Northern Engineering Works, Detroit, Mich., has recently installed Newten cupolas in the following foundries: Pocahontas Iron Works, South Norfolk, Va.; Mississippi Seating Co., Jackson, Miss.; Chickasaw Iron Works, Memphis, Tenn.; Noyes Stove Co., Waterville, Me., and the Progressive Stove Co., Colorado City, Colo.

The Hill & Griffith Co., Cincinnati, manufacturer of foundry facings, supplies and equipment, has recently sold one No. 60 Newten cupola to the John J. Bruce Foundry Co., Cincinnati, and one No. 54 Newten cupola to the Majestic Furnace and Foundry Co., Huntington, Ind.

The Paige Retort & Crucible Co., Taunton, Mass., has recently been formed for the manufacture of high grade retorts and crucibles. Enlargements are now under way on a factory building which has been secured at that place, and the new company expects to have its product on the market about Jan. 1. Edwin H. Paige is the treasurer and moving spirit of the organization. He has been identified with the manufacture of crucibles at Taunton for almost 20 years.

Alfred Field & Co., 93 Chambers street, New York, report that their sales of the Lion brand, wax wire core vent, for the past eight months have been heavier than in all the four years previous in which this article has been handled. They are putting out a clever advertising circular in the form of a legal document reciting the claims of certain imitators of this wax wire and ordering, to prove the futility of these claims, that all foundries send for a free sample of the Lion brand. This order is signed by A. Cleancast, justice.

Ph. Bonvillain & E. Ronceray, Philadelphia, report two recent orders of large size for their French molding machines, one from an extensive machine tool concern in Rhode Island and the other from a large manufacturer of electrical equipment in New England.



WADSWORTH SAND GRINDING MILL

SAND GRINDING MILL.

A sand grinding mill of novel design equipped with an overhead drive has been built by Geo. H. Wadsworth and installed in the plant of the Falls Rivet & Machine Co., Cuyahoga Falls, O., of which he is superintendent. The mill has already effected a great saving in the amount of new sand required in the production of cores and it is estimated that the machine will pay for itself in less than a year.

Realizing the advantages that can be derived daily in the foundry from mechanically treated sand, Mr. Wadsworth decided to install a mill and to obviate the exposure of the operating parts to the cutting action of the sand designed and built the machine as shown in the accompanying illustration. The housings are substantially built of structural shapes and with the driving mechanism overhead the working parts are kept practically free from sand. Furthermore, the use of steel shapes in the housings permits of almost any variation in the size of the mill, which can be built to accommodate wheels and pans of large and small diameters. The castings used in the mill can be employed in one of either a greater or smaller capacity than the one shown by enlarging the pan, which is of cast iron having a steel plate curbing bolted to it. By opening the discharge door the operation of the mill can be made practically continuous. All of the bearings are of ample size and the mill complete weighs about 25,000 pounds.

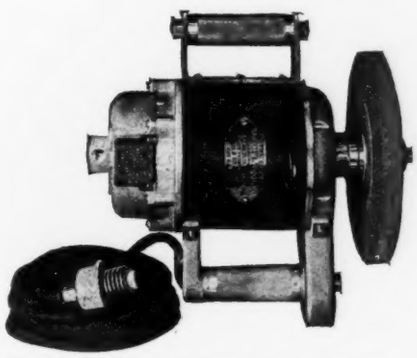
In the foundry of the Falls Rivet & Machine Co. the core mixture in the past consisted of approximately 50 per cent of new sharp sand and 50 per cent of new loam, together with a certain amount of dry core compound and flour. Ninety per cent of the old sand was discarded. When the new mill was placed in operation it was found that a large percentage of the dry core compound from the interior of the large cores had not been burned out and that it could be successfully used in compounding a new mixture. These experiments resulted in the adoption of a new mixture containing 90 per cent of old core sand and 10 per cent of new sharp sand, while the amount of dry core compound required has been reduced 50 per cent. By the addition of a small amount of molasses water the mixture is strengthened and the cores readily leave the castings.

The mill is not only adapted for grinding core sand, but also facing

sand, which is greatly improved in quality when mechanically treated in this way, and much cheaper material can be used in the mixture. The mill will be built for the foundry trade in various sizes to meet local requirements by the Falls Rivet & Machine Co., Cuyahoga Falls, O.

PORTABLE METAL GRINDING AND BUFFING MACHINE.

The accompanying illustration shows the new grinding machine manufactured by the Cincinnati Electrical Tool Co., Cincinnati. The operating and controlling switch is located in the right hand handle of the machine, thus obviating the necessity of the operator releasing his hold on the machine for starting and stopping. The bearings are made of phosphor bronze and are arranged for convenient lubrication and are provided with dust-proof oilers. The machine is air cooled by a rotary

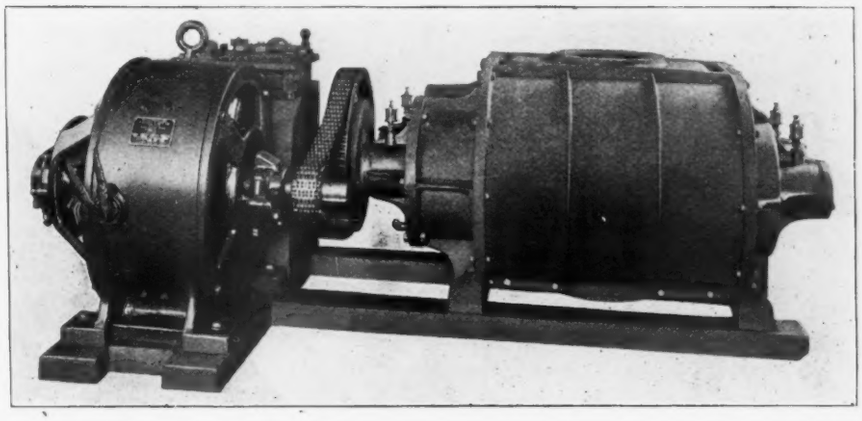


PORTABLE METAL GRINDING AND BUFFING MACHINE.

fan mounted directly on the armature shaft and it is arranged that the buffing wheel or special shaped emery wheel can be interchanged. It is furnished with an emery wheel 8 inches in diameter with a ¾-inch face. Dies can be ground by this machine while they are in the press, thus obviating the necessity of taking them out for this operation. The machine is provided with an eye bolt fitted on the top so that it can be suspended from a spring or provided with a cord and counterbalance which relieves the operator of its weight if so desired. It weighs 25 pounds complete and is furnished for 110, 220 or 550 volts, direct current, and can be wound for any special voltage from 75 to 650.

MOTOR DRIVEN BLOWERS.

During recent years the operation of nearly all kinds of machinery has been changing from belt or engine drive to a positive drive from motors and the question as to the best method of operating foundry blowers has been given considerable thought by both blower manufacturers and foundry owners.

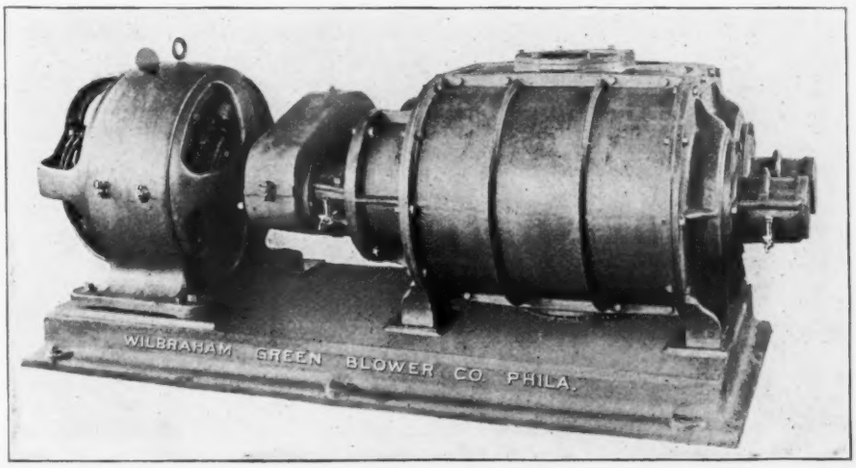


BLOWER OPERATED BY CHAIN DRIVE

In addition to the usual method of driving blowers with motor by means of the customary rawhide pinion and cut spur gear, the Wilbraham-Green Blower Co., Philadelphia, has for some time been successfully using a chain drive consisting of two sprocket wheels and a chain connecting the two, as shown in Fig. 1. This drive has proven very efficient, is almost noiseless, and has been used successfully on motor driven blowers ranging in size up to 200 cubic feet displacement per revolution. In using this method of driving blowers direct from the motor, it is unnecesssary to have the usual extended cast iron bed plate under the blower and motor required when the blower is driven by gearing as shown in Fig. 2.

The transmission gearing of the latter consists of a rawhide pinion for the motor shaft and a cut spur gear for the motor shaft, a cover being provided for both. The blowers shown are of the horizontal, single geared, 2-impeller type. The working parts consist of two single castings having no internal bolts to work loose and the operating parts are so designed that there is practically no internal friction. The shafts are forged steel and the journals are unusually large and run in bearings bushed with phosphor bronze. The blowers are very short in proportion to the displacement, which reduces the space required for a blower of a given capacity. The main driving gears are keyed directly onto the cast iron impellers and not to the impeller shafts. These gears are also enclosed in the main head plate casting, which permits them to run continuously in oil and at the same time they are absolutely protected.

The pulley of large driving gear on the extreme end of the impeller shaft is located next to the end of one of the main bearings of the blower, thus reducing the overhang and relieving the two driving gears on the impellers from any unnecessary shock or strain caused by the driving belt or gearing. The blowers can be run in either direction and are built in all sizes from one to five pounds by the Wilbraham-Green Blower Co., Philadelphia.



GEAR DRIVEN BLOWER

GENERAL INDUSTRIAL NOTES

The Ajax Mfg. Co., Cleveland, manufacturer of Blakeslee tools, which recently purchased a large tract of land in the northwestern part of the city, advises that it does not intend to erect any new factory buildings for at least 10 or 12 months. J. R. Blakeslee is president and general manager, and C. K. Dissette, secretary.

The Nortmann-Duffke Foundry Co., Milwaukee, maker of pressed and stamped steel work and crucible and gray iron castings, is repairing the buildings and machinery of its plant. Part of its force has been laid off temporarily, but the pressed steel department has work on hand for several months.

The Akron Brass & Bronze Foundry Co., Akron, O., has been incorporated with a capital of $10,000, by Jacob Adler, Henry M. Ehman, Max Holub, N. O. Mather and C. R. Grant.

The Michigan Crucible Steel Castings Co., Detroit, has repaired the damages resulting from its recent fire, and is once more in full operation. The loss was fully covered by insurance.

The Canon City Foundry & Machine Co., Canon City, Colo., has been chartered with an authorized capital of $12,000, by William Doller, John A. Marsden and John Hendricks.

The Delphos Foundry & Mfg. Co., Delphos, O., has been incorporated with a capital stock of $10,000. The incorporators are S. W. Sherry, John P. Fitzmartin, John D. Sherry, Anthony Heingartner, William C. Brunson and Henry Ostendorf.

New Construction.

W. J. Holloway, formerly of Fort Worth, Tex., is equipping a modern foundry at Stamford, Tex. It will be operated under the name of the Stamford Iron Works.

The Independent Harvester Co., Plano, Ill., has lately completed extensive improvements to its plant, added new machinery in several departments, and greatly increased its working force. The foundry building has been reinforced by a 25-foot concrete wall, a new roof with skylights will be added, and the foundry capacity will be doubled.

The American Brake Shoe & Foundry Co., Mahwah, N. J., has its new plant at Chattanooga, Tenn., ready for operation.

The Mayo Iron Works Co., Richmond, Va., which succeeded the Cameron-Tennant Co. last spring, has added an iron and brass foundry to its plant.

The Hudson & Sharp Foundry, Green Bay, Wis., is erecting a two-story brick addition.

The Rock Island Tool Co., Rock Island, Ill., has increased its capital stock for the purpose of building a new plant. The buildings will include a machine shop, 80 x 150 feet, foundry 70 x 120 feet, fireproof pattern storage 30 x 40 feet, and several other buildings. Some additional machinery will be installed in the spring. F. G. Young is president and treasurer, and C. E. Shields, secretary and manager.

The Scott Stove & Furnace Co., Cambridge City, Ind., is making rapid progress with its new plant, for which modern foundry and mounting room equipment will be required. The main building will be of brick and cement, 60 x 214 feet. This company was formerly the Scott National Radiator Co., Marion, Ind., and changed its name when it moved to Cambridge City a year ago.

The new plant of the Modern Foundry Co., Oakley, Cincinnati, will be ready for operation early in January. It will have a melting capacity of 50 tons per day and will supply all the castings for the extensive plant of the Cincinnati Milling Machine Co., which is being erected at Oakley.

The Marshall Car Wheel & Foundry Co., Marshall, Tex., is rebuilding the portion of its plant recently destroyed by fire. Two buildings, 87 x 250 feet and 56 x 280 feet, respectively, will be constructed of brick and steel and made absolutely fireproof. Several smaller buildings will be erected for warehouses and similar purposes.

The London Machine Tool Co., Hamilton, Ont., is erecting a new foundry, 68 x 144 feet, for which modern foundry machinery will be required. Contracts for electrical traveling cranes have already been placed.

The Bucyrus Steel Castings Co., Bucyrus, O., is having plans prepared for an addition to its plant, 150 x 400 feet, of steel and brick, on which work will be started early next year.

The Macbeth Iron Co., Cleveland, engineer, founder and machinist, has found a larger plant necessary for its increasing business, and has purchased 10 acres of land for the site of a new plant, including a large machine shop and foundry, which it hopes to erect during the coming year. The lot is situated on Madison avenue N. W., and has switching connections with the L. S. & M. S. railroad.

The Crescent Engineering Co., Newport, Tenn., manufacturer of gas and gasoline engines, pumping machinery, etc., is enlarging its plant by the addition of several buildings, including one for foundry purposes.

The Waterville Foundry & Machine Co., Waterville, N. Y., is completing its new stone building, 36 x 160 feet, which will be equipped and operated as a modern machine shop and foundry. This will replace the plant recently destroyed by fire. Considerable new equipment will be installed, though some of the old machinery has been rebuilt.

The Walworth Run Foundry Co., Cleveland, is building a new plant at West Twenty-seventh street and Felmore avenue in that city. The building will be 50 x 170 feet and four stories high, and will increase the company's facilities for manufacturing hot air registers and casing rings. No additional machinery will be required at present. W. Strangward is president and general manager, and G. F. Seelbach, secretary and treasurer.

Inmates of the Indiana reformatory at Jeffersonville have finished a new foundry at that institution. It is 320 x 138 feet and all of the work except the steel castings was done by the convicts. The product of the foundry will be purchased by the Indiana Mfg. Co., Peru, Ind.

The Columbus Malleable Casting Co., Columbus, O., which began operation with one furnace about four months ago, has completed its second furnace, which will give it a daily capacity of 35 tons. A large part of its output has been taken by the Ralston Steel Car Co.

The Los Angeles Foundry Co., Los Angeles, Cal., is erecting a foundry, 140 x 186 feet. The building is of steel construction, covered with corrugated iron, with cupola platform of reinforced concrete.

The Pittsburg Malleable Iron Co., Pittsburg, has made the necessary changes and repairs to its plant necessitated by the recent fire, and is again in operation.

The plant of the Zenith Foundry Co., Phelps, N. Y., which was recently destroyed by fire, will be replaced by a larger and more modern plant. The products of the company will be manufactured at the plant of the Crown Drill Works until the new plant is ready for operation.

The Iron City Sanitary Mfg. Co., Zelienople, Pa., will erect a new foundry building, 60 x 240 feet. It will be of steel and concrete construction and will be equipped to handle 2,000 castings per day. The molding and pouring will be continuous and an automatic conveyor for molds and sand will be installed. The equipment will also include 16 Herman pneumatic molding machines for large sanitary ware.

Brass Foundries.

The Lee Mfg. Co., Port Huron, Mich., manufacturer of automobile parts, injectors and ejectors, valves and brass and aluminum castings, has been succeeded by the South Park Mfg. Co., which was recently organized.

The Monarch Specialty Mfg. Co., Columbus, O., manufacturer of brass specialties, has lately been reorganized. George H. Marting has been made president and Alexander N. Flora, secretary and treasurer. Both were formerly connected with the Columbus Iron & Steel Co. The company is planning the erection of a new factory in the spring.

The Globe Brass Mfg. Co., Cleveland, has been incorporated with a capital stock of $50,000 by Christian Bohn, F. C. Schaefer, William B. Bohn, Henry F. Schroeder, and William F. Beek. A manufacturing plant for plumbers' brass goods will be fitted up at 418 Prospect avenue S. E., and the new company expects to be in operation by March 1. Christian Bohn will be president; E. H. Bohn, treasurer, and W. B. Bohn, secretary.

The plant of the Frankfort Brass Works, Frankfort, Ind., has been sold at receiver's sale to I. N. Perlstine, of Chicago, for the consideration of $9,000 and the assumption of a mortgage of $10,600. Mr. Perlstine is now endeavoring to obtain financial support in Frankfort, preparatory to again operating the plant.

The Artistic Bronze Co., Norwalk, Conn., has been incorporated to make and deal in brass and bronze fittings, fixtures and furnishings. The capital stock is $20,000 and the incorporators are: William C. Babson, South Orange, N. J.; Paul Syabo, Brooklyn, N. Y., and Gordon Grand, East Orange, N. J.

Interior Foundry View, Merrimac Iron Foundry, Lawrence, Mass.

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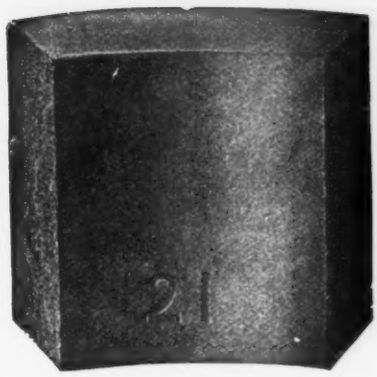

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Byram & Co., Detroit.
Detroit Foundry Supply Co., Detroit.
Etting, Edward J., Philadelphia.
Gilmour, J., New York.
McCormick, J. S. Co., Pittsburg.
Paxson, J. W. Co., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.
Wonham & Magor, New York.

Electric Generating Sets:
Sturtevant, B. F. Co., Hyde Park, Mass.

Elevators:
Curtis & Co. Mfg. Co., St. Louis.
Ridgway, Craig, & Son, Coatesville, Pa.

Engines (Steam):
American Blower Co., Detroit.

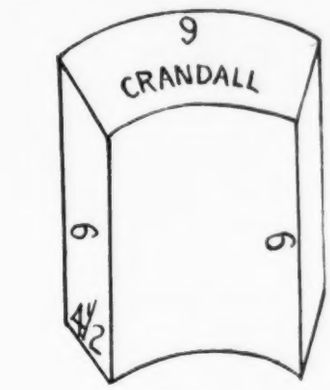
Engineers (Foundry, Mech., Elec., Etc.):
Carr & Speer, New York City.
Dodge & Day, Philadelphia.
Hooper, Geo. K., New York City.
Lindsay, W. W. & Co., Philadelphia.
Seaver, John W., Cleveland.

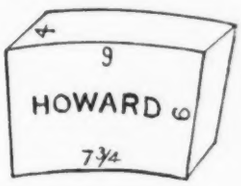
Exhausters (Gas):
Wilbraham-Green Blower Co., Philadelphia.

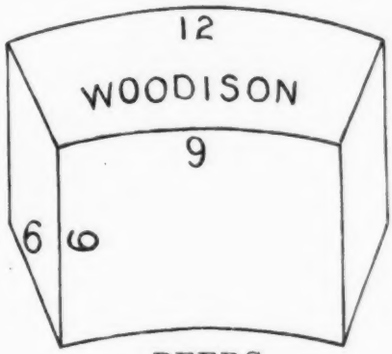
Economy

The Watchword of the Foundryman

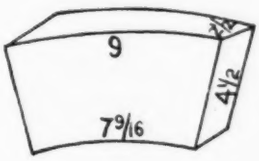
SOME buyers consider prices only, consider a cupola block as a cupola block, not the material in it. It may be cheap, both as to cost and contents. It costs just as much to reline your cupola with a poor, as a good quality, with the advantage of the good one lasting probably two or three times as long. Give a little thought to the cost of the completed structure and buy a block or brick guaranteed to do your work.







BEERS



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No.	1—16"	inside	diameter,	25"	outside	diameter.
No.	2—21"	,,	,,	30"	,,	,,
No.	3—27"	,,	,,	36"	,,	,,
No.	4—30"	,,	,,	39"	,,	,,
No.	5—40"	,,	,,	49"	,,	,,
No.	6—51"	,,	,,	60"	,,	,,
No.	7—60"	,,	,,	69"	,,	,,
No.	8—75"	,,	,,	84"	,,	,,

HOWARD

No.	1—30"	inside	diameter,	42"	outside	diameter.
No.	2—36"	,,	,,	48"	,,	,,
No.	3—48"	,,	,,	60"	,,	,,
No.	4—60"	,,	,,	72"	,,	,,
No.	5—72"	,,	,,	84"	,,	,,

WOODISON

No.	1—30"	inside	diameter,	42"	outside	diameter.
No.	2—36"	,,	,,	48"	,,	,,
No.	3—42"	,,	,,	54"	,,	,,
No.	4—48"	,,	,,	60"	,,	,,
No.	5—54"	,,	,,	66"	,,	,,
No.	6—76"	,,	,,	88"	,,	,,

BEERS

No.	8—24"	inside	diameter,	33"	outside	diameter.
No.	9—30"	,,	,,	39"	,,	,,
No.	10—36"	,,	,,	45"	,,	,,
No.	11—48"	,,	,,	57"	,,	,,
No.	12—60"	,,	,,	69"	,,	,,

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FACING MILLS:
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Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.
Pettinos Bros., Bethlehem, Pa.
Stevens, F. B., Detroit.
United States Graphite Co., The, Saginaw, Mich.

Fans:

American Blower Co., Detroit.

Ferro-Manganese:

Metallic Alloys Co., New York City.
Rogers, Brown & Co., Cincinnati.
Western Foundry Supply Co., E. St. Louis, Ill., New York City.

Ferro-Silicon:

Roessler & Hasslacher Chemical Co., New York.
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Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

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Detroit Foundry Supply Co., Detroit.
Gautier, J. H. & Co., Jersey City.
Harbison & Walker, Pittsburg.
Maurer, Henry, & Son, New York.
Laclede-Christy Clay Products Co., St. Louis.
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Carborundum Co., Niagara Falls, N. Y.

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Barnett, Oscar, Fdy. Co., Newark.
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Killing Molding Machine Co., Davenport, Ia.

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Diamond Clamp & Flask Co., Richmond, Ind.
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Paxson, J. W. Co., Philadelphia.

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Obermayer, S. Co., Cincinnati.
Pangborn, Thos. W. Co., New York.
Sly, W. W. Mfg. Co., Cleveland.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

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Crivel & Co., Geo. F., Buffalo.
Detroit Foundry Supply Co., Detroit.
Hill & Griffith Co., Cincinnati.
McCormick, J. S. Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn, Thos. W. Co., New York.
Paxson, J. W. Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, A. L., San Francisco.
Taylor, Robert J., Inc., Philadelphia.
Whitehead Bros. Co., New York, Providence, Buffalo.

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Monarch Engineering & Mfg. Co., Baltimore.
Paxson, J. W. Co., Philadelphia.
Rockwell Engineering Co., New York.

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Dixon Crucible Co., Jos., Jersey City.

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Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Venderbush & Looman, Detroit.

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McCormick Co., J. S., Pittsburg.
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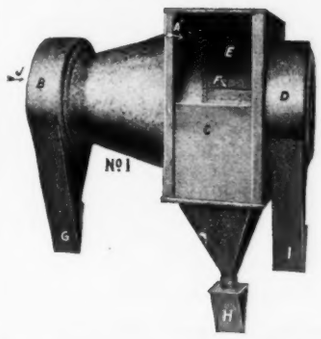

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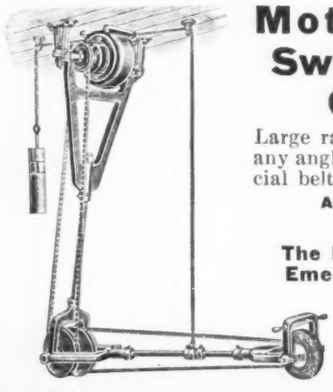

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SUPERINTENDENT WANTED BY BRASS foundry with present capacity of 150 tons per month, modern machinery and laboratory. Must have experience in rolling mill and blast furnace work, also phosphor bronze and general line of bearing metals. Give experience, with whom, and salary expected. Address Box 704, THE FOUNDRY, Cleveland, O.

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EXPERIENCED COREMAKERS WANTed for southern pipe foundry. Good wages and steady work. Address P. O. Box 81, Birmingham, Ala.

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INVENTORS ATTENTION: MERITOrious patented foundry machinery manufactured on royalty basis. Long experience and unexcelled facilities for reaching foundry trade. Whiting Foundry Equipment Company, Harvey (Chicago Suburb), Ill.

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WILL TAKE INTO PARTNERSHIP practical man thoroughly experienced in some business closely connected with castings. Have now jobbing brass foundry of high repute near New York which is progressive. Future assured. Address Box 711, THE FOUNDRY, Cleveland, O.

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THREE 24-INCH HINGED TABOR molding machines for sale, also one 36-inch Hinged Tabor Molding Machine. The above are practically new and ready for immediate shipment at very much less rates than factory prices. The Exeter Machine Works, Pittston, Pa.

FOUR ARCADE MOLDING MACHINES for sale at a sacrifice. Acme Steel & Malleable Iron Works, Buffalo, N. Y.

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One 20-ton Air Melting Furnace (Cupola).
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SECOND-HAND FOUNDRY EQUIPMENT wanted, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, Ohio.

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A 60-INCH CUPOLA WANTED, ALSO foundry rattles, sand mixer and ladles. Materne Manufacturing Company, St. Louis, Mo.

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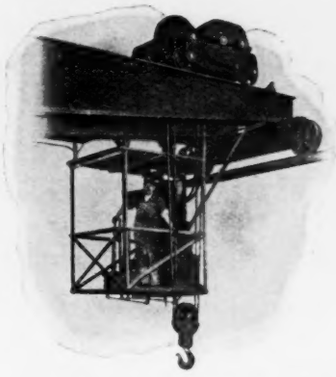

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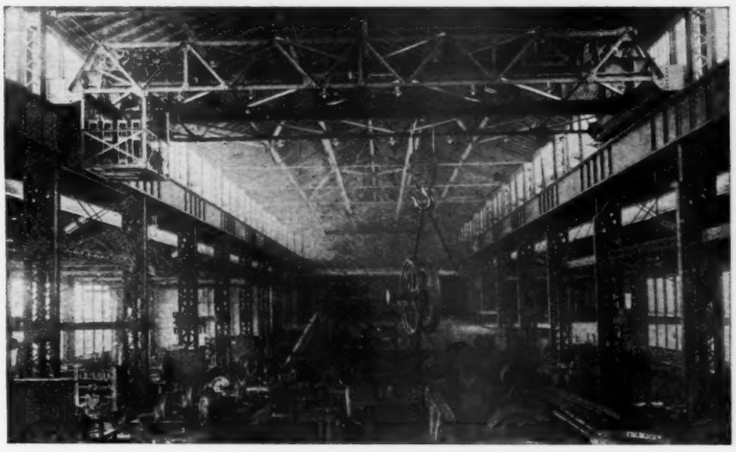

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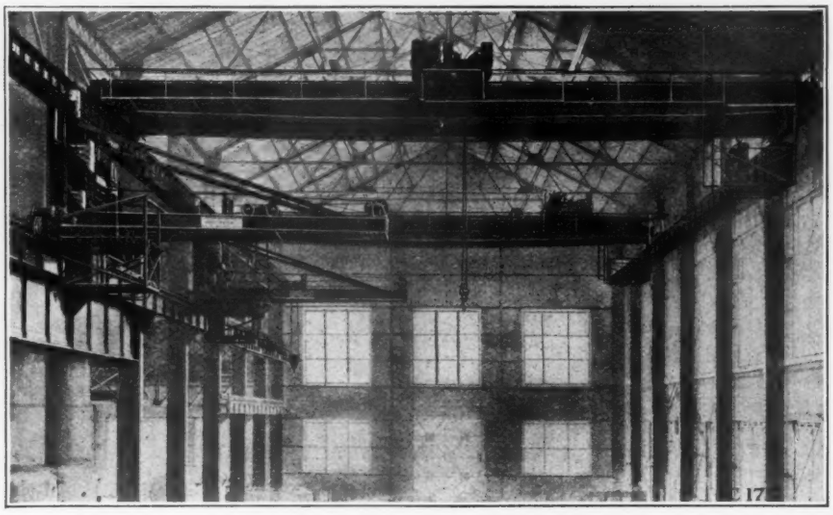

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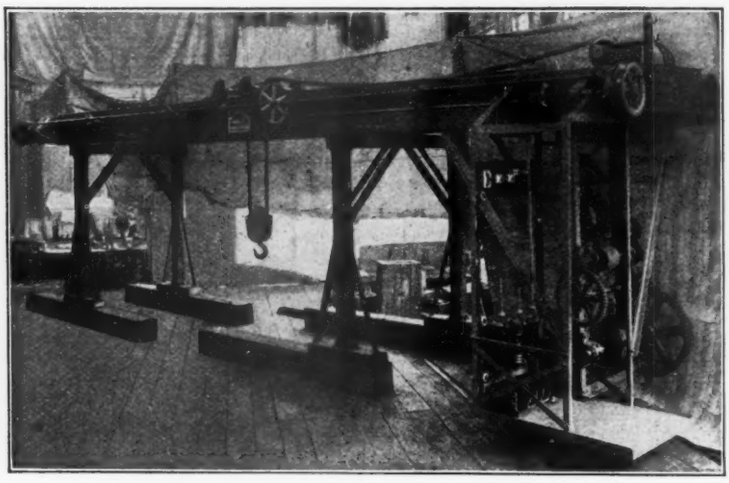

WHERE the head room is limited and the ladle of hot metal comes close up to the bridge, it is desirable to keep the hoist and motor away from the heat. In addition to the usual automatic electric and mechanical brakes the hoist is provided with a hand brake which gives absolute control of the lifting speed from full speed with a full load, to a few inches a minute for drawing patterns.

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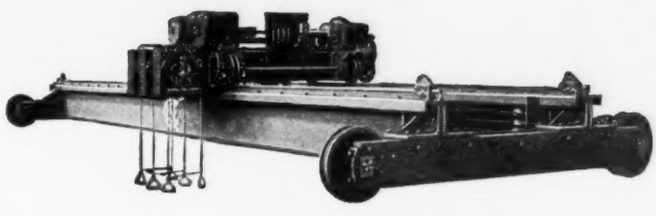

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They are always ready and can be operated by any workman.

They are faster and work easier and smoother than any hoist yet produced. PEERLESS HOISTS have fewer strands of chain than any other hoists of equal capacities.

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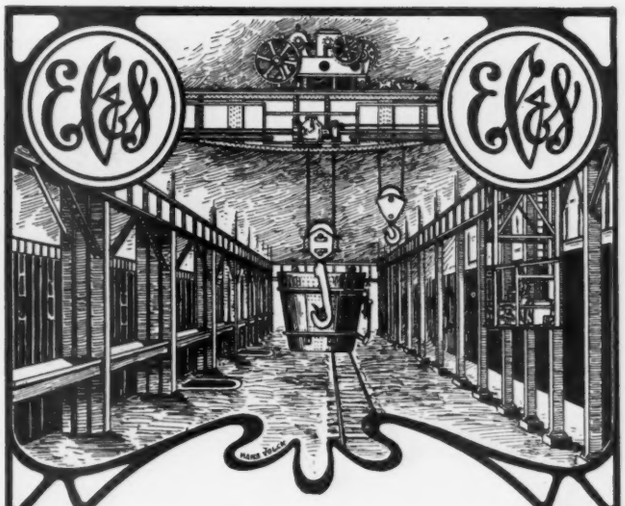

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DEPENDS LARGELY UPON THE CONTROLLERS USED ON YOUR CRANE.

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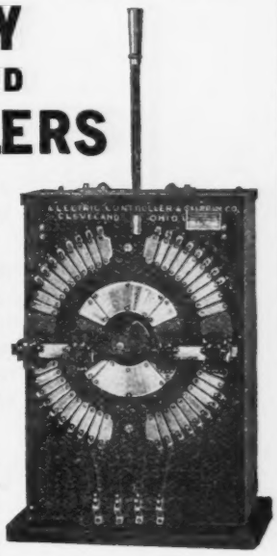

are the product of ten years of progressive development.

The original type was brought out at the Homestead Steel Works of the Carnegie Steel Co., to meet the special requirements of steel mill service.

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Send for Bulletin No. 99 giving details of construction.

The Electric Controller & Supply Co.
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The Moyer Tramrail System

¶Now then, Mr. Foundryman,

¶We want you to put your time against ours.

¶We want you to send us a plan of your foundry, drawn to scale, showing the cupola, the girders, the molding floors, the distance from the foundry floor to the underside of the girders; show the position of your core ovens and your rumblers.

¶And tell us whether carrying metal or sand, or cores, or flasks, or all four appeals to you most.

FIG. 5—TRAMRAIL LAYOUT IN FRONT OF THE CUPOLAS.

¶Then **we** will make up a detailed working plan of your foundry, showing the "MOYER TRAMRAIL SYSTEM" installed.

¶We will tell you how it can be installed.

¶We will tell you what the **"System"** will cost you f. o. b. your city.

¶We'll tell you just where the "System" will save for you.

¶And how much it will save—and why.

¶It will cost you very little to send such a plan.

¶The quicker the "MOYER TRAMRAIL SYSTEM" begins to work for you, the quicker the savings will pile up. So, better send the plan along today. It's up to you now. We're ready.

FIG. 6—RACKS FOR HANDLING CORES

¶We have just published Bulletin No. 102 showing actual photographs of the Moyer Tramrail System for Foundry use EXCLUSIVELY.

¶The book shows just how pig, coke and scrap can be carried to the CHARGING FLOOR.

¶How the HOT METAL and CORES are carried to the MOLDERS.

¶How the FINISHED CASTINGS go to the rumblers, to the grinders, to the stock bins.

¶"102" shows the CHEAPEST method known of handling both BRASS and IRON, and a lot of other things of interest to the Foundry Trade.

¶We'll be glad to send you a copy of the bulletin if you will write us on your LETTER HEAD, just say—

"Let Bulletin No. 102 come along."

¶We'll know what to do.

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Tramrail Co.
130 South Third Street
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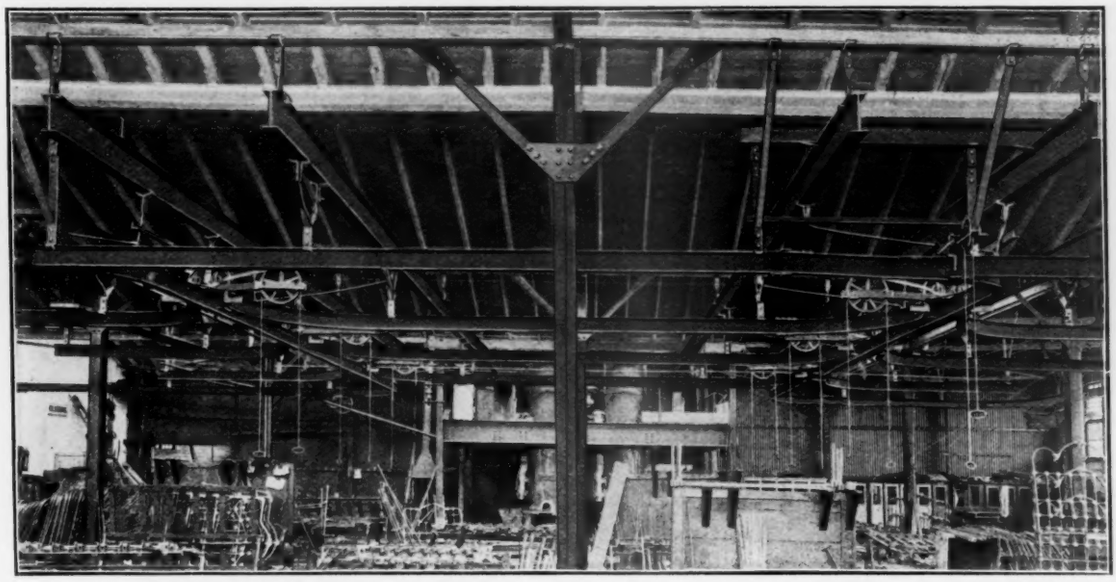

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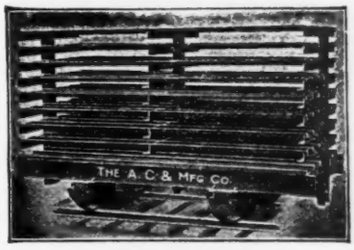

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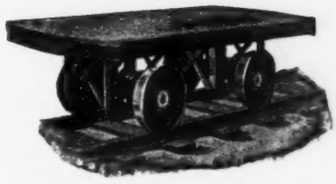

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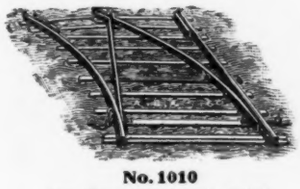

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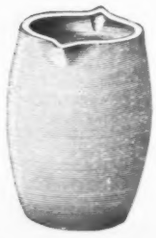

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